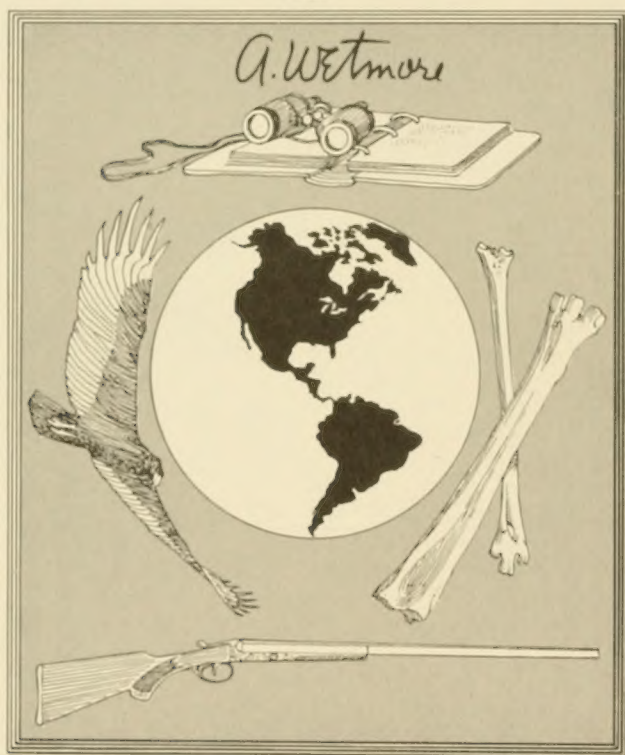
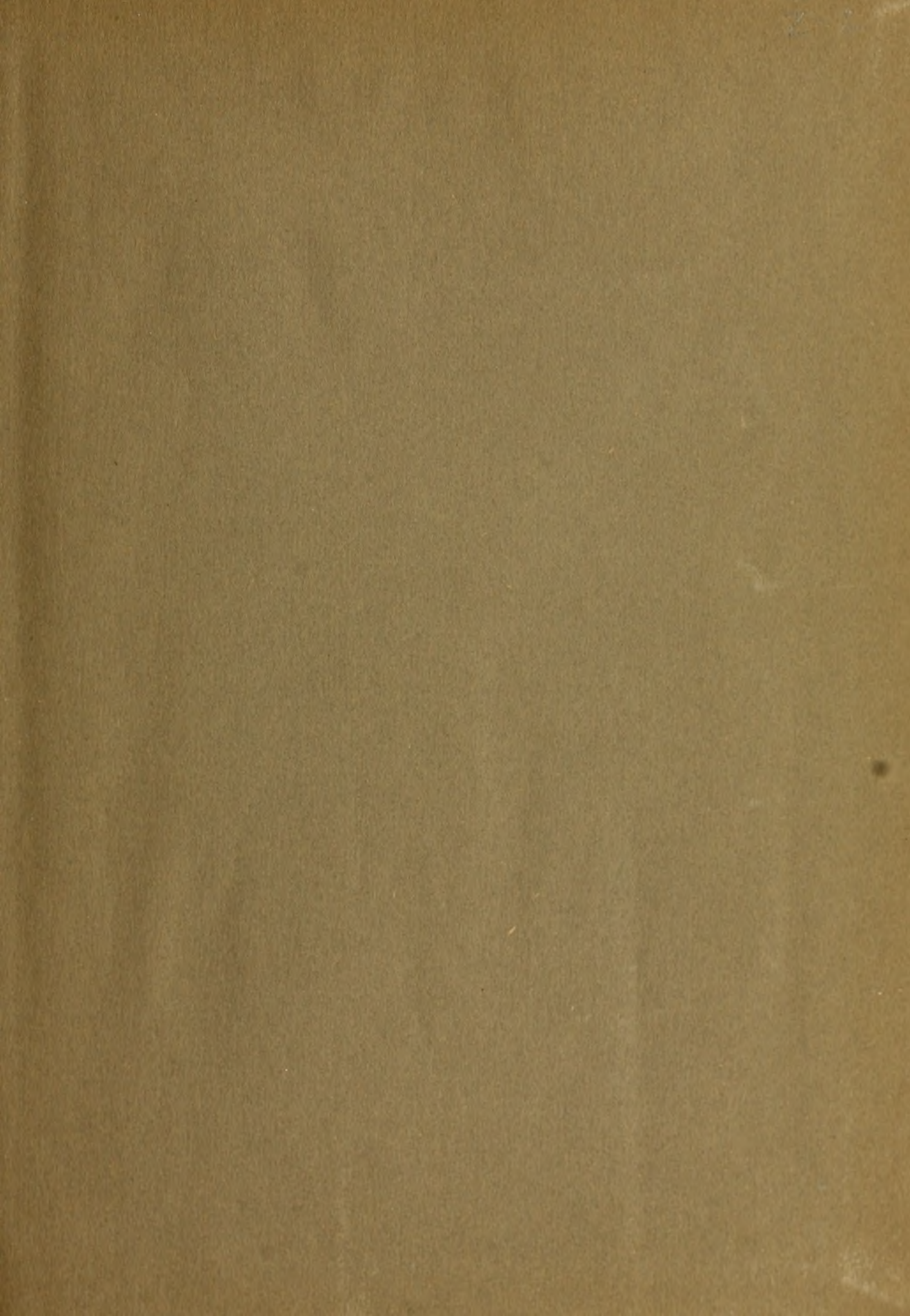


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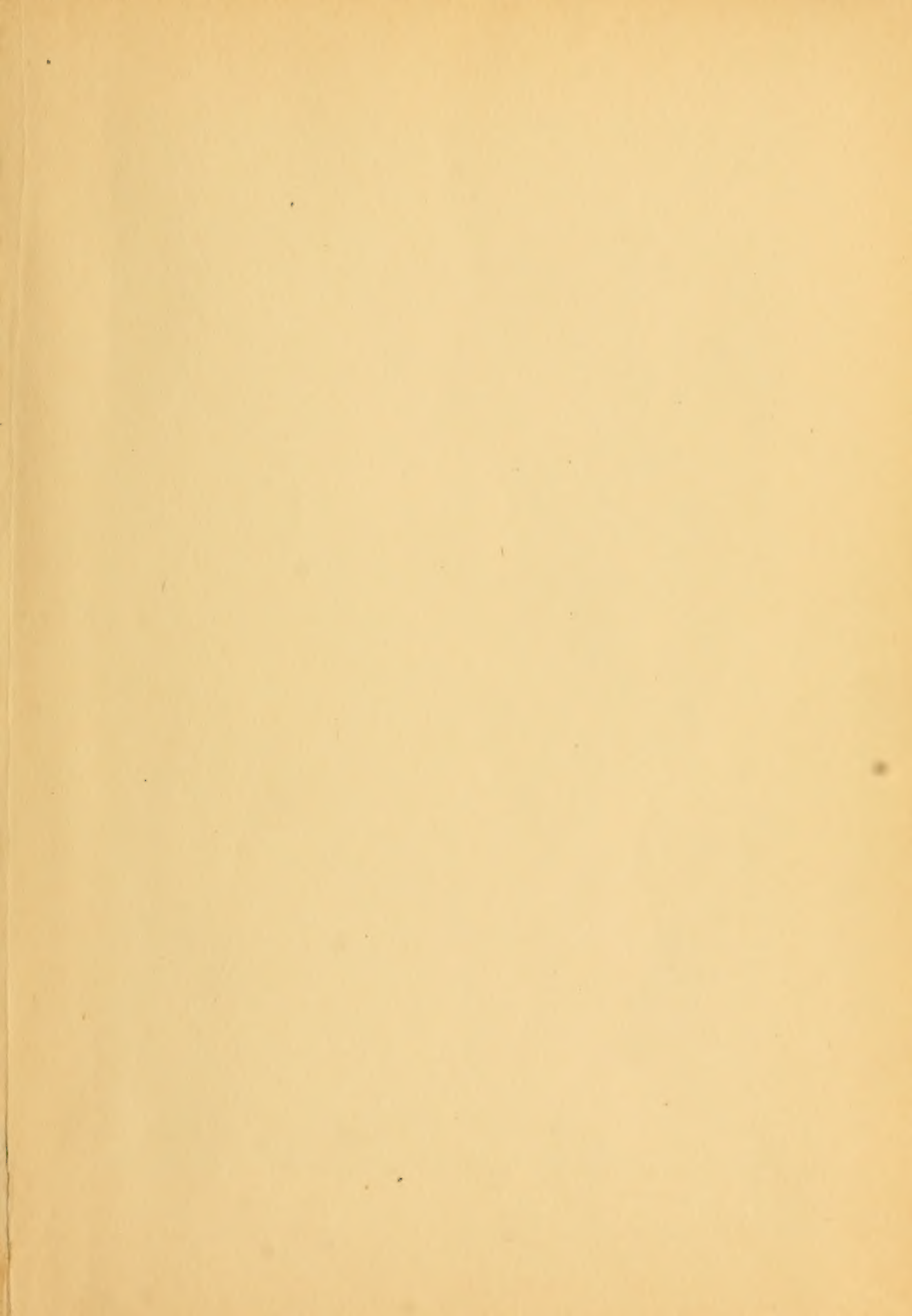
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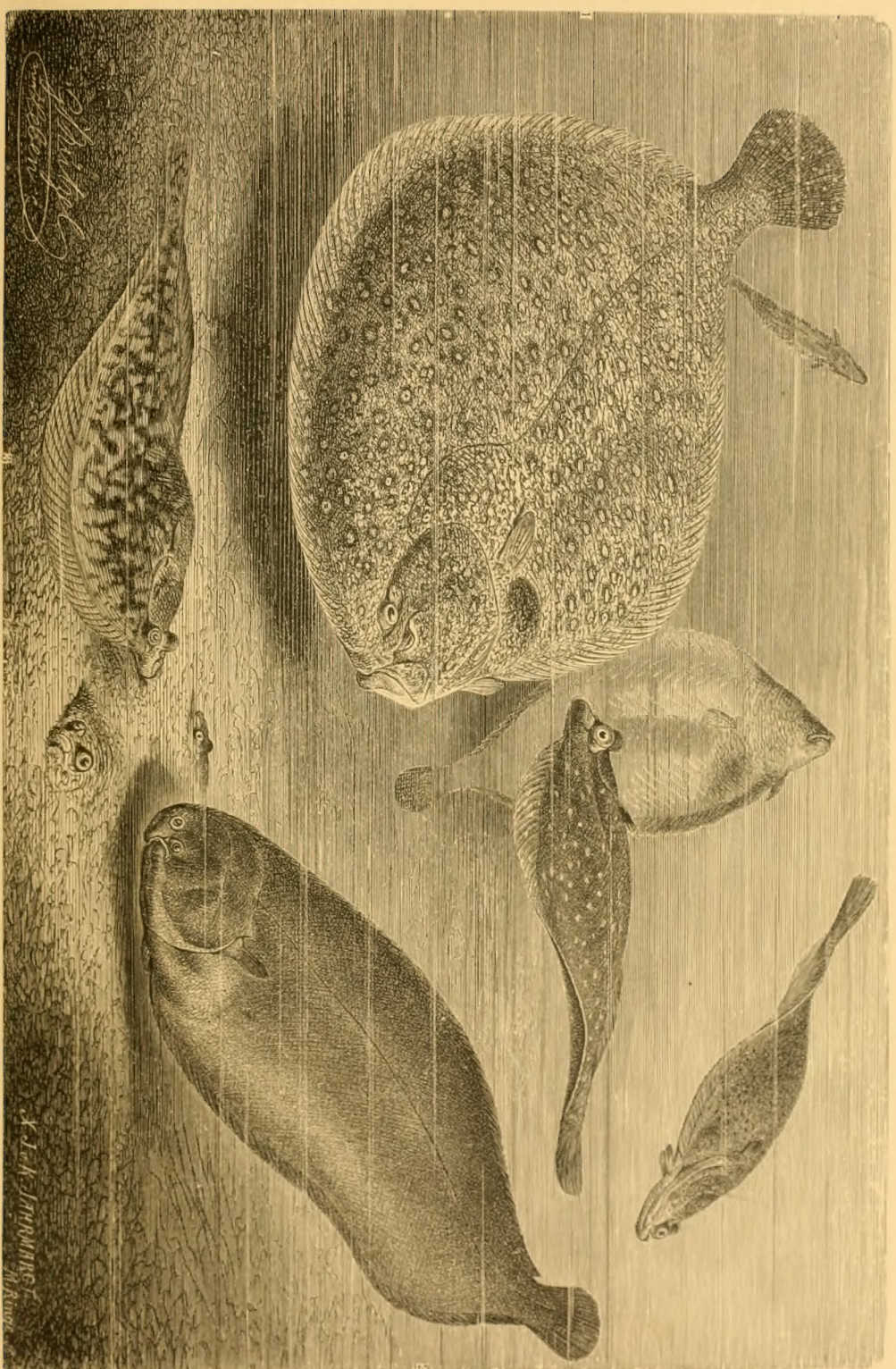
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FLAT FISHES.

1. *Psetta maxima*, turbot ; 2. *Solea solea*, sole ; 3. *Pleuronectes platessa*, plaice.



Samoan Islanders picking Cotton.

Dr. Alexander McNamee
with the kind regards
of Leonard Stejneger

April 23, 1928

NATURAL HISTORY OF BIRDS.

CLASS IX. — AVES.

A BIRD is known by its feathers. Indeed, so distinctive is this sentence that it does not admit of a single exception, for no bird is without feathers, and no animal is invested with feathers except the birds. And so singularly adapted is this covering to the aerial habits of most of the members of the bird class, that its structure is nearly the same in all flying birds, while the only aberrant types of feathers are found in the ostriches, the kiwis, and the penguins, all of which are deprived of the power of flight. In the two first-mentioned groups the feathers resemble hairs more or less superficially, and the representatives of the last order present a plumage somewhat suggestive of scales, but both the hair-like and the scale-like appendages are in every respect true feathers. Not less remarkable as indicative of the perfection of the feather is the fact that the feathers of the oldest bird known, the fossil *Archæopteryx* from Solenhofen, were essentially like those of the majority of existing birds, and that nature has not been able to improve much upon that admirable combination of lightness and firmness since the Jurassic period.

But the feather is not the only characteristic attribute of the birds, although it is the only one which at once distinguishes them from all other living beings. From the reptiles the feathered tribes differ, among other things, in possessing a complete double circulation of the blood, which is warm, while the absence of milk glands separates them widely from the mammals. Further characters which separate the birds from the mammals are the single condyle of the occiput, and the articulation of the lower jaw with a separate bone, the *os quadratum*, which again articulates with the skull. The absence of a diaphragm may also be quoted in this connection. In these and several other particulars the birds show a near relationship to the reptiles, so close, indeed, that they have been included with them in a separate group, Sauropsida; at any rate, the birds are more nearly related to the reptiles than they are to the mammals, notwithstanding the beak of the duck-mole and the recent re-discovery of the fact that the *Echidna* lays eggs, and whatever was the origin of the mammals, so much is certain, that they sprang from an ancestral stock with which the birds are only remotely connected. Their position between the reptiles and the mammals in our linear system does not indicate any intermediate position in nature, but is simply due to our inability of expressing exact relationships on a flat sheet of paper.

There are other features which frequently are attributed to the bird class as diagnostic, but which really are of but little account; for instance, the modification of the jaws into a beak sheathed with horn and destitute of teeth, for not only have the

turtles and the duck-mole similar beaks, but we know now that teeth were as common in certain groups of extinct birds as they are in reptiles or mammals nowadays. Nor is the laying of eggs and their hatching an exclusive characteristic of the feathered tribes, for we have birds which leave the hatching to be done by the heat of decaying vegetable matter heaped upon them, while the latest indications are that the old report of the Monotremes laying eggs, hitherto regarded as a fable, is substantially true. The so-called 'pneumacity' of the bird-skeleton, or the peculiarity of the bones being hollow and filled with air through the canals in connection with the respiratory organs, has also been regarded as belonging to the birds only, but the bones of the extinct Pterosaurians and some other forms were also filled with air, air-canals being present in nearly all the bones of the skeletons of the larger species, while several recent birds, for instance the kiwis and the penguins, are entirely destitute of pneumacity in any part of the skeleton.

We will mention one more character which cannot be upheld as peculiar to the birds in view of our present knowledge. It is well known that in birds the different bones of the skull grow together at an early age, fusing so completely that the borders of the individual bones are completely obliterated, while in most other vertebrates these bones remain separated by sutures during the whole lifetime of the animal. Still there have been found remains of an extinct bird, the remarkable *Gastornis*, in which the sutures were permanent, while, on the other hand, all tends to show that the ancient Pterosaurians had the different pieces of the skull fused together as completely and as early as any bird now living.

Since we thus have to fall back upon the feathers as the most distinctive feature of a bird, a brief comment upon their structure and origin may not be out of place. Comparing the scales of reptiles, the feathers of birds, and the hairs of mammals, the popular verdict would probably be in favor of regarding the hairs and the feathers as more resembling one another than either of them do the scales, particularly when we remember the many hair-like appendages in birds. Scientific investigation, however, seemed to prove the correctness of quite the opposite view, and the alleged identity of scales and feathers has been frequently used as a further argument for the close relationship between reptiles and birds, the scale-like feathers along the edge of the penguin's wing being regarded as a structure intermediate in character between the two kinds of integument and a proof of their common origin, while much stress was laid upon the differences between hair and feather. True, the latter differ radically, particularly in their early stages, for a hair is formed in a solid ingrowth of the epidermis, while the feather originates on the top of a large papilla; but the homology of the latter with the scales of the reptiles is not therefore a sure thing, and Mr. J. A. Jeffries has recently brought forward arguments which indicate a different nature of the two structures, the strongest being that feathers may grow upon scuta. It should also be remarked that the above-mentioned scale-like feathers of the penguin are in every respect true feathers, and not half feather, half scale.

Young birds, when breaking the egg enclosing them, vary greatly in their development, some being quite naked, as, for example, most Passeres, Picarie, herons, and cormorants, but soon assuming a more or less full covering of soft down, which again is replaced by firmer feathers; other kinds are not hatched before the downy clothing is perfected within the egg-shell, while the final feather plumage is put on afterwards; the former are called *Gymnopædes* (*gymnos*, naked; *paides*, children); the latter group; *Dasypædes* (*dasys*, downy). All the *Gymnopædes* are fed in the nest by the

parents (Altrices), and so are many of those which are born down-clad, but a great number of the latter are able to run about immediately upon leaving the egg (Præcoces). A few birds remain so long within the egg that the feathers are developed before the shell bursts, this being the case with the young talegallas, and these might be called Pteropædes.

As remarked above, the feather is formed on a dermal papilla. At an early stage such papillæ arise above the surface of the skin, each of which is grooved longitudinally on one side. This median groove sends off laterally numerous smaller ones in an obliquely upward direction, gradually becoming shallower. The secretion of the papilla moulds in these furrows, and, when pushed upward by new formations below, dries and splits into a feather, consisting of a scape and disconnected lateral barbs. These imperfect feathers are called plumules, and, taken collectively, constitute the down. While the papilla from which these plumules were formed sinks later on into a pit or follicle of the skin, another crop of more perfect feathers starts from papillæ at the bottom of pits which are situated at the intersections of numerous ridges of the skin (the latter without sudoriferous glands and sebaceous follicles). These papillæ are more deeply grooved, and have, moreover, very often a corresponding but slighter furrow on the opposite side, from which originates a usually small extra feather, known as the after-shaft (hyporachis), and attached to the under side of the main shaft. These stronger and more perfect feathers, which are called contour feathers, consist of a central stem and a lateral 'web' on each side. The former is composed of two parts; a lower, cylindrical, and hollow portion, the quill proper, enclosing the papilla, which shrivels when the feather ceases to grow; it merges into the terminal part, the shaft, which is four-sided and solid, and from which spring two lateral sets of barbs or radii; these have on their margins secondary processes, barbules, which by means of small hooks or barbicels interlock with the neighboring barbs, thus uniting them into continuous and elastic 'webs,' termed the inner or outer web, according to the relative position to the median line of the body.

Only in a few of the recent birds, as in penguins and ostriches, are the feathers distributed evenly over the whole body. In all Euornithes they are arranged in special and regular groups or tracts (pterylæ), separated by naked or downy spaces (apteria), which are concealed by the overlying feathers of the neighboring tracts, an arrangement by which smoothness of the plumage is secured whatever movement the bird may undertake. It may be regarded as a rule that the smaller the feathers in a tract the smaller are the separating spaces, the latter sometimes becoming so narrow as to be nearly obliterated. The different grouping of the tracts, their distribution and ramification, are subject to considerable variation, and are to a certain extent valuable for systematic purposes, because sometimes diagnostic of important divisions.

Two of the pteryllæ are of special interest and importance—the alar and the caudal tracts, both including the strongest feathers of the whole body. From the former spring the remiges, which form the essential part of the wing, and without which no bird can fly. Those which are fixed to the hand are called *primaries*; *secondaries* are those on the forearm, the three innermost of which are styled *tertaries*. The number of primaries is usually ten, often nine, very seldom eleven; that of secondaries from six to forty. The bases of these are overlaid by several rows of larger and smaller contour feathers, the upper or under wing coverts, according to their position on the upper or lower surface of the wing. For further detail we refer to the accompanying cut, which will give more information at a glance than we can detail in

a long description; but we would like to call attention to the middle row (*mc* in the figure), the so-called 'middle coverts,' which in many birds, particularly among the

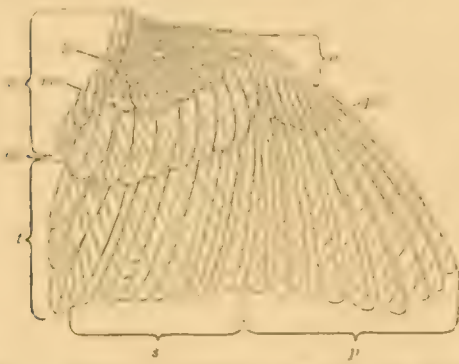


FIG. 1.—Feathers of a passerine wing, seen from above; *a*, alula; *p*, primaries; *lc*, lesser coverts; *gc*, greater coverts; *pc*, primary coverts; *mc*, middle coverts; *s*, secondaries; *sc*, scapulars; *t*, tertiaries.

Passerines, are arranged in a manner different from the other feathers, as they overlap each other with their inner edges, while all the other feathers have the outer margin free, and the inner one covered by the overlying feathers. The caudal tract embraces the tail feathers (rectrices) and their upper and under coverts. They are in pairs, and are counted from the outside towards the centre. Their number varies from eight to thirty-two, but twelve is the rule, less the rare exception.

Besides these normal feathers there are several modifications for special purposes; filoplumes, with slender axis and rudimental barbs, are often merely for ornament, while the hair-like vibrissæ, which have no barbs at all, line the mouths of many insect-eating birds, and the eyelids of many birds of prey, toucans, and ostriches. "Some plumes have the barb-tips breaking off as dust (powder-down), and these may be scattered (and transitory, as in the lammergeier), or dorsal, or on each side of the spinal tract (some kites); or post-femoral and inguinal (herons, *Leptosoma*, tinamous)." We may also mention the so-called semiplumes, feathers intermediate between contour feathers and down, and occupying the edges of the feather-tracts; in the hoatzin the apteria are nearly filled with them, and Garrod asks why they may not be regarded as degenerated feathers; they are usually concealed by the contour feathers, but long semiplumes are found in some forms, as, for instance, the ornamental feathers in the Marabou stork (*Leptoptilos dubius*).

Feathers, generally, do not, like hairs, continue to grow indefinitely. Where they have attained their full size, the vascular papilla enclosed in the quill dries up, forming the 'pith,' and from that moment no further growth, nor any renewing of tissue, takes place in the feather. Therefore, as soon as the feathers are worn out, they are thrown off, shed, and replaced by an outgrowth of new ones. This process, which we call molting, presents some variations and modifications in the different groups of birds, but may, as a rule, be said to take place annually after the breeding season, with its wear and tear to the feathers, is over. During this general molt, all the feathers, including wing and tail feathers, are shed gradually, and equally, on both sides of the median line of the body; the feather of one wing is thrown off simultaneously with the corresponding one of the other, and the same relation takes place in the molt of the feathers in each half of the tail. It is the exception, when ducks and some other birds lose all the wing feathers at once, thus being deprived of the power of flight for a short time. While wing and tail feathers are only molted once a year, a partial molt of the smaller feathers often takes place early in spring, at which time also most of the ornamental feathers, borne only a short time, make their appearance. This renewal of a part of the plumage is generally very rapid, and the time between the autumnal total molt and the partial one in spring, as a rule, perhaps, shorter than between the spring and the autumn changes, sometimes being often a brief period of

a few weeks, as in the eiders (*Somateria*), but we have, on the other hand, examples of the reverse, as in the ptarmigans (*Lagopus*), some of which, at least, show the peculiarity of a permanent molt during the whole summer. Many birds retain the first plumage during the first winter of their life, while others change it a short time after they have put it on; and in some—for instance, in the grouse family—even the wing-feathers are shed before the first winter sets in. Very frequently the new plumage has a color quite different from the one which was thrown off, and particularly where two molts occur, the seasonal change in the color of many birds is thus accounted for. But there are a whole category of cases in which a radical change in the coloration according to season is effected without the feathers being molted. In many birds, notably among the Passeres, the feathers of the new autumnal plumage will be seen to be parti-colored, the centre being of a hue different from that of the edge. Let us examine the fall plumage, for instance, of the adult common snow-bunting (*Plectrophanes nivalis*). The general color is white, the back, however, spotted with black, and parts of the plumage, especially the head, suffused with brownish; looking closer at the individual feathers, we find that those on the back are really black, with broad white margins, while the white feathers of the head are tipped with brownish. These edges and borders become very brittle towards the approach of next year's breeding season; they fall off, leaving the black feather-centres of the back and the pure white part of the other feathers exposed, so that the bird next summer appears white, with black back. It is a similar process which changes the appearance of the bobolink (*Dolichonyx oryzivorus*), besides that of numerous other birds, so radically.

Changes in color may also take place between the molts and independent of the edge-shedding. In most birds the color of the plumage changes notably towards the end of the breeding season: wing-feathers which formerly were black become light brownish or grayish, vivid colors become dull, and a general fading seems to take place, caused by the wear and tear, rubbing, direct influence of the atmosphere, of rain, and of sunshine, or, as we are accustomed to call it, by abrasion. But the colors may also be intensified, or even radically changed, by abrasion, provided the superficial layers which rub off are of such a nature as to conceal or obscure the deeper and differently colored strata. We may mention the common red-poll (*Acanthis linaria*) as an example. It is but fair to confess, however, that our knowledge of the change of color in the individual feather, after having finished its growth, is still very defective, and that we have to look toward future investigations for answers to many a question. The same remark applies to our knowledge of the pigments in feathers which produce the colors. A coloring matter which is called zoomelanin, and thought to be identical with coriosulphurine, seems to produce all the black and dark hues in birds, while some green colors are due to an admixture of a yellowish pigment called psittacofulvine. A really green pigment has only been found in the touraços,—hence the name turacoverdin,—and no blue or violet pigment has yet been discovered, while red (zoöerythrine) is quite common. Another red, turacin, causes the magnificent red on the wings of the Musophagidæ. There is no white pigment, but wherever that color occurs it is due to the countless number of interstices between the molecules of the feather, the substance of the latter being colorless. Many tints—for example, blue, violet, and certain greens—are not due to the pigment, which is black-brown to yellow, but the blue results from a particular surface-structure of the feathers, so that it must disappear if the color-producing parts be destroyed. Thus, if

we hammer carefully the deep blue feathers of a macaw, the blue color immediately disappears, and the injured part looks gray or brownish, according to the underlying pigment. Some green parrot feathers, when treated in a similar way, become yellow, since this is the color of their pigment. Here we have the explanation of the dark appearance of the abraded parts of feathers of parrots and other brightly colored birds.

The gloss of feathers, independent of the color itself, is the result of their surface being smooth and polished, while the metallic lustre is due to a transparent sheath which acts like a prism, a fact ascertained by Mr. Gadow. The theory of the metallic lustre being due to structure of a prismatic nature originated, however, with Professor B. Altum.

We mentioned above that the seasonal shedding of feathers or of their edges usually causes a change in the color of the plumage. In some birds we distinguish summer and winter plumages, in others nuptial and post-nuptial garbs, and in some ptarmigan may be observed even four more or less distinct attires nearly corresponding to the four seasons.

There are also some interesting relations connected with the similarity and dissimilarity in color between the two sexes, and between the adults and the young. Though it might seem to be the original arrangement, or perhaps just, therefore, young birds and the adults of both sexes and at all seasons are comparatively seldom quite alike. The Procellariidæ, or petrels, may be quoted as an example, besides several others. If the adults of both sexes, for some reason or another, have developed alike seasonal colors, the first plumage of the young is very often like that which the parents assume about the same time,—that is to say, their post-nuptial or winter dress. In such a case the young birds undergo a change in the spring similar to that of the old ones; many of the auks (*Alcidæ*) demonstrate this rule. Whenever one of the adults, no matter what sex, is more richly colored than its mate, the young usually resemble the more plainly colored of the parents; this rule is followed by a great many, perhaps the majority of birds, but exceptions and many modifications occur. We are, however, justified in making this generalization, that species in which both parents differ materially from the plumage of the young are still more specialized as to color than the foregoing categories; for we may without hesitation take for granted that the plumage of the young is the more generalized, and that the amount of specialization is in proportion to the departure from the first garb. It follows that we have to go to the birds in the later plumage, or in that more like it, whenever we wish to ascertain the relationship of different forms. It will, therefore, be necessary to arrange the species according to the characters furnished by the young, or plain-colored females, and not by the secondary, often highly specialized, structure of the males, if we aim at a natural classification based upon affinities. It will seem as if there may be a possibility of finding out the relation between the different classes of plumages, so that it might be deduced whether one kind of plumage in a given case—for instance, a barred or spotted one—is a more specialized condition than another, say a striped or plain dress; but no investigations, covering a sufficient number of species of all orders and from all parts of the world, have been made as yet, without which all generalizations and speculations are premature and next to valueless.

Finally, we have to consider a color problem which has only come forward of late, and which still awaits its solution. There has been invented a name for the phenomenon, and we are accustomed to call it dichromatism, but of its true nature and its

significance in the animal economy we are quite ignorant. By this term we designate the peculiarity in certain species of birds, that individuals present two different styles of coloration, or 'phases,' presumably more or less independent of geographical distribution, present or past, or, in fact, of any apparent cause whatsoever. The difficulty in finding a plausible theory is much increased by the circumstance that there are nearly as many kinds of dichromatism as there are dichromatic species. We shall mention a few examples. It has been known that the so-called Richardson's jäger (*Stercorarius parasiticus*) appears in two different styles, one uniformly sooty all over, the other with the whole under side white. At one time they were regarded as different species, while some observers thought that the difference was a sexual one; but it is now demonstrated beyond doubt that the white and the dark bird are only individual phases of the same species, irrespective of sex or locality. It is interesting to remark that the closely allied species *S. longicaudus* has only one, the light phase. The relation between the common and the spectacled murre (*Uria troile* and *ringvici*) seems to be somewhat similar, the latter having a white ring round the eye and a post-ocular stripe which is wanting in the former, a strong argument being the relative paucity of the spectacled form, in connection with the fact that it does not occur in any locality where the plain-colored one is not found. A more striking and also more puzzling example of dichromatism is exhibited by several members of the heron family, a question which has been particularly studied by Mr. R. Ridgway. Already Peale's egret and Wurdeman's heron have disappeared, as separate species, from the lists of North American birds. It is regarded as proven that the former is only a white phase of the reddish egret (*Dichromanassa rufa*, the generic name of which has been given according to this view); for, according to Ridgway, in Florida, where they breed abundantly, both forms have been found in the *same nest*, attended by parents either both reddish, both white, or one in each of these stages of plumage, other circumstances at the same time leading to the conclusion that the two phases are not only not specifically distinct, but that they have nothing to do with either sex, age, or season. In the little blue heron (*Florida carulea*) the facts are still more convincing; for here the white phase is seldom, if ever, perfectly developed in the adults, while intermediate specimens are much more numerous. The question is considerably more complicated when we come to the great white and the great blue herons of this country. We shall state the facts briefly, first giving a clue to the different forms, which may be distinguished thus:—

Legs olive; size larger,	$\left\{ \begin{array}{l} \textit{Ardea occidentalis}, \text{ white all over.} \\ \textit{Ardea wurdemanni}, \text{ parti-colored; occiput and plumes white.} \\ \textit{Ardea wardi}, \end{array} \right\}$	
Legs black; size smaller,		$\textit{Ardea herodias},$

No white phase of *herodias* is as yet known, which seems rather strange when we consider that *Ardea wardi*, which is almost an exact counterpart of *A. herodias*, except in the coloration of the legs and the size, is matched so absolutely by *A. occidentalis*, as far as structure is concerned, that the two could not possibly be told apart if the colored bird be bleached so as to become pure white. The same may be said of *A. wurdemanni*, and we might be led to suppose a kind of trichromatism, the white *occidentalis* with two different colored phases, were it not for the fact that the type specimen of *A. wurdemanni* is still unique, and therefore most probably nothing more than an individual variety, or an adolescent bird not having yet lost the last traces of

the young plumage. Candor compels us to state, however, that the evidence for the white and the colored birds being only phases is yet insufficient, the more so as geographical distribution seems to have something to do with the matter, for it is stated that, in Florida, the white birds are confined mainly to the Atlantic coast, while the colored ones chiefly inhabit the Gulf side. The example from the herons can be nearly duplicated by the status of some forms of fulmars from the northern Atlantic and Pacific oceans, although in this case the geographical distribution seems to be a moment of still greater importance, for I think I have proved that, in both oceans, the dark phases are predominant to the westward. We have other examples of dichromatism in the same group as the dark and the white form of *Ossifraga gigantea*; and Mr. Ridgway's suggestion, that it will be found more extensively all through the superfamily of the Tubinares or Procellarioideæ, is well worth consideration. Dichromatism among the owls, or erythrochromism, as it is here called, because of rufous being the color producing one of the phases, is not uncommon, but seems to be still more influenced by the geographical distribution, at least in our little screech owl (*Megascops asio*), which, in the Mississippi Valley, has more rufous than gray individuals, in the Atlantic states both phases nearly equally represented, while west of and including the Rocky Mountains, only gray birds occur. Want of space compels us to pass in silence many more examples, for instance, the white and the blue-winged snowgeese, the dark and light-colored phases of many hawks (*Buteo*es), but we cannot dismiss this matter without having mentioned that most perplexing question to American ornithologists: What are the relations of the two forms of flickers (*Colaptes*) and their numerous intermediate individuals? The two flickers are mainly characterized by the color of the under surface of the wing and tail feathers, these being red in the red-shafted (*Colaptes mexicanus*), gamboge yellow in the yellow-shafted flicker (*C. auratus*), in addition to which the latter has a red nuchal crescent; besides, the males are distinguished by having a malar stripe, which is red in the red-shafted species, but black in the other; the former is chiefly a western bird, the latter inhabits the east and the north. Hardly two species could look more distinct than the typical specimens of these remarkable birds; but the characters are mixed in every possible degree in the individuals inhabiting the region intermediate between the two, to such an extent as to be completely without parallel among birds. They were generally declared to be hybrids until intermediate specimens were found in localities—for example, Florida—where only one of the typical species occur, and, consequently, hybridity is an impossibility. Are they incipient species? are they local varieties? or what? As there are no structural characters involved, the question is merely one of color; why then not seek refuge in 'dichromatism' or rather 'trichromatism,' affected by geographical distribution, it is true, but not in the usual way, as there are geographical sub-species of the common kind besides. We shall not attempt a solution here, but would like to put the question thus: Why may not the birds with red crescent and red moustache (this probably being the most numerous form of the so-called 'hybridus'), be the original stock, which, westward, became modified into *mexicanus*, eastward into *auratus*, the isolated individuals, with mixed characters, being due to atavism, or occasional outbreak of the characters of the original stock, while a great many of the mixed individuals from the intermediate region might be regarded as products of hybridization? In other words, why not a trichromatism on the verge of forming three different species, or two if—as would be expected—the original (intermediate) stock died out at last? A point which seems to strengthen such a view is the fact

that there exists another yellow-shafted species with red mystacial stripe and red nuchal crescent, viz., *Colaptes chrysoides*. If this theory be correct, we would have a clew to another class of dichromatic species, viz., those which now are stereotyped into two invariable forms or species, separated geographically, but still identical in structure. We shall only mention an example recently brought forward by Mr. Ridgway, that of the scarlet and the white ibises (*Guara rubra* and *alba*), of which he very characteristically remarks that they are now so different in color that probably nobody would deny their specific distinction, though structurally so alike that a specimen of the white one dyed scarlet would be indistinguishable from *G. rubra*. The question which finally impresses itself upon the inquirer, in view of the above facts, is this: Are not the two or three 'phases' of dichromatic or trichromatic species 'incipient species,' the final fate of which will be that of the white and the scarlet ibises?

We have enlarged considerably upon this subject, because it is one of the most perplexing, and, consequently, most interesting questions in modern ornithology. It shows what we know, and particularly what we do not know; it shows that ornithology means more than a mere description and naming of birds, that one of its aims is to contribute to the solution of the great problem of the age: "The origin of species."

Besides feathers, we recognize in birds other epidermal appendages, as the horny sheaths of the beak, the teeth in some extinct forms, the scaly covering of the feet, spurs, and nails. Most of these different structures will be more advantageously treated of in other connections, and under the head of such groups in which they may be of special interest, although we wish here to call attention to the fact that parts of the horny beak and the nails of the toes may be shed in a way analogous to that of the molt of the feathers, referring, as we do, to the deciduous nature of the basal parts of the bill in several members of the auk family (pullins and dwarf-auks), to the 'centre-board' of the white pelican's bill, and to the seasonal claw-molt in the grouse-family, particularly the ptarmigans. The most primitive form of the horny covering of the feet seems to be its division into uniform hexagonal scales, and is called reticulate; the next stage is when some of these scales fuse together, forming what is termed scuta, or scutella, which particularly cover the anterior part of the tarsus and the upper surface of the toes; still further specialization is indicated by the tarsal scuta fusing into a continuous covering which, in its extreme development, embraces both the front and the back of the tarsus, as in some of the higher group of passerine birds; such a tarsus is said to be 'booted.'

It has already been remarked that the skin has no sudoriferous glands nor sebaceous follicles; but we cannot dismiss the dermal system before having mentioned the bilobed oil-gland placed at the base of the tail-feathers on the 'popo's nose,' and seldom missing, as it is in the ostriches and some few other birds. When 'preening' their feathers, birds press the fatty substance out of this oil-box with their beaks, and by passing each feather between the mandibles, anoint the whole plumage in order to keep it in repair and protect it against getting wet, as particularly noticeable in water birds.

Turning now to the other structural systems of the bird's body, it is not our intention to enlarge upon or even mention such general features as are regularly found in the text-books, only those being deemed worth our attention, in the present connection, which are of particular importance for an intelligent understanding of modern ornithological classification, or questions which at present are most occupying the lovers of our beautiful science.

The different bones of the head anchylose very early, it being a distinctive character of all living birds to possess a continuous skull-case without sutures; but it must be borne in mind that we know of an extinct group of birds, the Gastornithes, in which the sutures were permanent. Notwithstanding a general uniformity in the bird cranium, certain variations of the osteological structure, particularly of the palate and the base of the skull, have of late obtained a great prominence as systematic characters by the investigations of Professor Huxley, and his famous classification of the birds based upon them. Although not prepared to attach so great an importance to these features as has been attributed to them by many ornithologists, we will have to pay special attention to them, as in many cases they play a rôle in the ornithological classification similar to that of the teeth in mammals.



FIG. 2.—Under view of the skull of the emu (*Dromæognathous*); *bptp*, basipterygoid process of the sphenoid; *mnp*, maxillo-palatine; *pl*, palatine; *pmr*, pra-maxill.; *pt*, pterygoid; *vo*, vomer; *R*, basisphenoidal rostrum.

Professor Huxley distinguished four different types of the palate, which he has called *dromæognathous*, *schizognathous*, *desmognathous*, and *agithognathous*, and Professor Parker has separated a fifth type, which he styles *sauvognathous*. Referring for explanation to the accompanying cuts, which will give the desired information much easier than the best description, we abstain from any detailed account, only calling attention in a few words to the most salient features. Fig. 2 represents the *dromæognathous* structure of the palate, as found in the emu and, with some modifications, in the other ostriches and the tinamous. In

these, to use Huxley's own words, "the posterior ends of the palatines (*pl*) and the anterior ends of the pterygoids (*pt*) are very imperfectly, or not at all, articulated with the basisphenoidal rostrum (*R*), being usually separated from it, and supported, by the broad, cleft, hinder end of the vomer" (*vo*). The rest of the birds, consequently, have the palatine and pterygoid bones articulating with the sphenoidal rostrum, and not borne up by the posterior ends of the vomer. The arrangement illustrated by Fig. 3 is the one called *desmognathous*, since the maxillo-palatines (*mnp*) are united medially in the palate (*desmos*, a bond), the vomer, at the same time being rudimentary, or quite absent, as, for instance, in ducks, flamingos, herons, cormorants, pelicans, birds of prey, parrots, cuckoos, etc. Fig. 4 shows a palate quite different. Here is a cleft between the maxillo-palatines (*mnp*), and another between them and the vomer (*vo*), hence the name *schizognathous* (*schizo*, I cleave); but, in addition to this, the character of the vomer, being pointed in front, is essential, since by this mark the true *schizognathous* birds, — for instance, the penguins, auks, gulls, snipes, fowls, grouse, pigeons, etc., — are separated from another great group of birds, which have the palate "agithognathous, or sparrow-like, for in these, as exemplified by



FIG. 3.—Under view of the skull of a cormorant (*Desmognathous*). The letters as before.

Fig. 5, we also find the maxillo-palatines (*map*) separate medially and from the vomer (*vo*), but the latter is truncate in front and cleft behind, embracing the basisphenoid rostrum (*R*) between its forks. Finally, the saurognathous palate, which is peculiar to the super-family Picoidea, is particularly remarkable for having the two lateral halves of the vomer separate.

It may be well, however, to state that these characters are by no means always very trenchant, as two types often intergrade insensibly, while in other cases we find them sharply expressed in nearly related forms, as an example of which we shall only mention the closely allied genera *Megalaima* and *Tetraxonops*, besides several of the birds of prey.

The anterior nostrils are situated at the base of the beak (except in some Struthious birds, for example, *Apteryx*, in which they open near its tip), and may have a well-defined and rounded hinder edge, a condition called holorhinal by Professor Garrod, or be prolonged backwards as a fissure, when the term schizorhinal is used. A peculiar feature of the bird's beak is the flexibility of its union to the frontals by the long nasals and frontal processes of the premaxillæ; this is carried to an extreme in the parrots, in which the connection between the beak and the forehead is formed by a movable joint. The two halves of the lower jaw ankylose early, except in some fossil forms, and the symphysis (and consequently the gonys) is of very varying length. None of the recent birds have teeth in their jaws, and this negative character was a long time regarded as

distinctive of the class, as compared with the great majority of reptiles and mammals. Rudimentary teeth have lately been demonstrated in the grooves of the lower jaw of the embryonic penguin. It is also claimed that rudiments of teeth, in sockets and covered by dentine, have been found in embryos of parrots. Late investigations have failed to discover the dentine. Besides, important groups of fossil birds have of late been discovered, which were more or less richly supplied with teeth; as, for instance, *Archæopteryx*, *Laopteryx*, *Gastornis*, *Argillornis*, *Hesperornis*, *Ichthyornis*: the last had teeth in sockets, while those of *Hesperornis* were fixed in grooves, and were shed in a similar way to those of the reptiles.



FIG. 5.—Under view of the skull of a sparrow (agithognathous). The letters as before.



FIG. 4.—Under view of the skull of the capercaille (schizognathous). The letters as before.

The "saddle-shaped" vertebra is peculiar to the bird class, that is to say, the vast majority of living birds have the antesacral vertebrae saddle-shaped, a form not seen elsewhere; but opisthocœlian vertebrae may occasionally occur, being even the rule among the penguins, while biconcave or amphicœlian vertebrae, such as we find in fishes and many batrachians and reptiles, particularly fossil forms, are one of the most remarkable features of the extinct *Archæopteryx*, *Ichthyornis*, *Aptornis*, and, probably, *Laopteryx*. The number of cervical vertebrae varies between nine and twenty-five, those of the dorsal region between four and eleven, or, exceptionally,

only three; the latter are firmly anchylosed with the lumbo-sacral vertebrae, except in the penguins. Caudal vertebrae occur in numbers from seven to fifteen (21?), the largest number being found in the sub-class Saururae, embracing the Jurassic *Archæopteryx*. Next in number comes *Hesperornis*, from the cretaceous formation, with twelve, while most of the living birds have from seven to ten. In *Archæopteryx* they were all free, each supporting a pair of tail feathers; in *Hesperornis* the last ones were anchylosed, and there is reason to believe that it had no rectrices at all; in other birds, the last ones, which are still separate in the embryo, become fused completely together in the adults, so as to form a single bone, which, from its peculiar shape, has been called the 'ploughshare bone,' or the pygostyle; it supports the oil-glands, and, indirectly, the rectrices, which, on account of the shortening of the tail, have been forced out to the extreme end of the vertebral column. It has been suggested that the number of rectrices correspond with the number of caudal vertebrae, including those forming the pygostyle.

The breast-bone is generally provided with a keel, which, however, becomes greatly reduced or is wanting altogether in those forms in which the fore limbs have ceased to act as locomotive organs (wings or paddles), as, for instance the ostriches, kiwis, *Hesperornis*, *Notornis*, the dodo, *Cnemidornis*, and the large ground-parrot or kakapo (*Strigops*) from New Zealand. It must be remembered that a sternal (episternal) keel is not an entirely unknown thing among the reptiles. Sternal ribs are connected with the foremost dorsal ribs by hinge joints; the ribs are provided with uncinate processes; these are wanting in the fossil *Archæopteryx* and in *Chauna* among living birds, but are, on the other hand, found in some reptiles, for example, in *Hatteria* and in the crocodiles.

The shoulder girdle consists of a long, narrow, and curved scapula, a form which among the reptiles is found in the pterodactyls; while, on the other hand, the shoulder bone is quite flattened and broadened behind in the penguins. The collar-bones usually unite into a 'wish-bone,' or 'merrythought' (*Furculum*). They are separate in a few forms, as in the emu and some owls, while they are altogether absent in the ostrich, the kiwis, a few parrots, etc. The arm-bones offer but little for remark. We may refer to the arrangement of the elbow-joint, which is so constructed as to allow movement in one plane for extension and flexion only, but not for supination and pronation; the same remark applies to the carpal joint; both joints are stiff and nearly immovable in the penguins. Birds have, when adults, usually two carpal bones, one ulnar and one radial (as have also the crocodiles), but a few deprived of the power of flight — for instance, the cassowary and the kiwi — have only a single carpal. It is interesting to note that this was also the condition in *Archæopteryx*. The metacarpals are usually three in number and more or less fused together, that of the first finger, or pollex, generally being indicated by a process at the proximal end of the second metatarsal. *Archæopteryx* differs remarkably by having all three metacarpals free and well developed. The carpus is sometimes provided on the anterior side with an accessory bone supporting a thick, horny spur, as in the screamer, the spurwinged goose, and others, which should not be confounded with the claws at the end of the fingers, a mistake not at all uncommon.

Corresponding to the three metacarpals, the number of the fingers is also three, a free pollex being absent in the penguins and cassowaries, however. Judging from the number of phalanges in the three fingers left, — the radial one usually having one, the middle finger three or two, and the ulnar finger sometimes three, but oftener two or

one,—the fingers which are lost are the fourth and fifth. When two-jointed, the pollex, or first finger, usually carries a pointed claw, and so may also the second one, if three-jointed. The third finger only supports a claw in *Archæopteryx* (three-jointed). A reduction in the number of phalanges is noticeable as correlated with specialization in other directions, hence being found commonly among the so-called 'higher' birds.

When the wings are closed, the bones are usually folded up in such a way that the hand forms a sharp angle with and underneath the forearm, so that the tips of the fingers point backward; this is not the case with the Struthionine birds, in which the hand is directed forward. In the penguins the joints are nearly inflexible, and the hand is directed downward nearly in the prolongation of the axis of the forearm.

Reserving the account of the different structures of the pelvis to the remarks heading those groups in which it is of special interest, we would here only call attention to Professor Marsh's discovery of the separate condition of the pelvic elements in *Archæopteryx*, in contradistinction to other birds in which they are ankylosed together in the adult state, and to the loose way in which the pelvic bones are fixed to the vertebral column in the penguins.

In all birds the thigh bone is shorter than the tibia, a relation nearly unknown among the reptiles; the same proportion is found, however, in the very bird-like, but still indisputably Dinosaurian reptile, *Composognathus*, from the Jurassic formation, and in the Pterodactyls. The femoro-caudal muscle, which, for example, produces the curious sideways movement of the duck's tail, is in some birds inserted upon a trochanter of the femur, which, according to Professor Dollo, is the homologue of the third, or, as he proposes to call it, the fourth trochanter of the *Iguanodon*. The tibia is sometimes provided with a large cnemial process in front of the knee, as in the loons and grebes and the extinct *Hesperornis* and *Cnemioornis*; the fibula is usually more or less rudimentary; as a peculiarity of that part in *Archæopteryx* may be mentioned that its distal end was placed in front of the tibia, as in *Iguanodon*, a position unknown in other birds. The part following is the tarsus, but the collection of small bones designated by that term do not appear in the adult bird, for one of them, at least,—viz., the astragalus,—ankyloses early to the lower end of the tibia, while the others, in the same manner, are fused together with the metatarsals. The joint between the leg and the foot, therefore, is no true ankle-joint, but mesotarsal (inter-tarsal) articulation. This is a reptilian feature, and the recognition of the true nature of this joint is of considerable importance. It should also be borne in mind that the bone which in topographical ornithology is termed 'tarsus' consists chiefly of the three metatarsals fused together, and should consequently be styled metatarsus. In the embryonic bird these three elements are separate, and in the penguins they remain distinct, as only the ends grow together. The condition of the metatarsus in *Archæopteryx* may have been similar, judging from the two deep grooves on the anterior surface of it. The metatarsal of the first toe (hallux) is very small, and usually free. The toes are in the great majority four; viz., the first, second, third, and fourth, the fifth being always absent both in recent and in fossil birds. The first is often wanting, but in many cases where it is not seen outside the skin it may be found underneath it. The second is rudimentary in a few genera of kingfishers, and the fourth in *Cholornis*. Rarely the number of toes is reduced to two (the ostrich), the first and second being atrophied. The normal number of phalanges are two, three, four, and five in the first, second, third, and fourth toe respectively, and the inner phalanx is the longer one, the

ratio of the others decreasing gradually toward the ends. By progressive specialization the number of phalanges is often reduced, *e.g.*, in some swifts which have only two, three, three, and three phalanges respectively, and the proportion of their length modified.

Concerning the muscles of birds, we should like to enlarge upon the mechanism moving the wings, and that wonderful arrangement by which the toes of the perching bird are automatically kept in a grasping position by means of the bird's own weight alone; but want of space permits us only to mention and explain a few technical terms and signs which will be found useful further on. The late Professor Garrod used the letters A, B, X, and Y to represent certain muscles of the thighs which he considered to be of particular taxonomic value, *viz.*, respectively, the femoro-caudal, the accessory femoro-caudal, the semi-tendinosus, and the accessory semi-tendinosus; thus, saying that the muscular formula of the secretary bird is BXY means that the three latter are present. The formula A in the falcon means that none but the first-mentioned is to be found.

Besides the above, two other muscles belong to the femoral region of birds, the account of which we shall give as nearly as possible in the late Professor Forbes's words, *viz.*, the *gluteus primus* and the *ambiens*. The former is, as a rule, not small, and is only seldom absent, *e.g.*, in the Bucerotidae and Palamedeidae; the latter, the *ambiens*, lies on the lower or inner surface of the thigh. As generally developed, it is a more or less slender fusiform muscle, which, arising from the prepubic process of the pelvis, close in front of the acetabulum, runs along the inner side of the thigh superficially, and then, as a thin tendon, over the bend of the knee—in some cases perforating the patella—to the outer side of the leg, terminating there by joining one of the tendons of the superficial flexor of the toes. In all passerine birds, and some others, it is always absent; these are termed anomalognatous birds, in contradistinction to the more generalized types which are homologonatus, and we denote the presence or absence of the *ambiens* muscle by the signs + or —.

In all birds there are two deep flexor muscles of the toes, the tendons of which run along the posterior (plantar) aspect of the metatarsus, one the deep flexor of the first toe (*f. longus hallucis*), the other closing the remainder of the toes, *flexor perforans digitorum*, the former being always external to, or superficial of, the latter when passing the metatarsus. In all Passeres and a few other birds, *e.g.* *Upupa*, these tendons are quite independent of each other, so that if the flexor of the first toe be artificially pulled, no closing (flexion) of the other ones takes place. In all other birds, however, the two tendons are more or less intimately connected by a fibrous band (*vinculum*), or may even completely blend.

By far the most interesting feature, however, brought out by Prof. Garrod's investigations into this subject is the discovery of the existence of the entirely different types of plantar arrangement in the so-called zygodactyle birds (with usually two toes in front and two turned backward), as well as the fact that the diversity of type exactly coincides with the two groups of birds so marked out, being respectively homologous and anomalognatous. Thus in the parrots, cuckoos, and Musophagidae, which all belong to the former group, the plantar tendons are distributed in exactly the same way as in the common fowl, the *flexor perforans* supplying second, third, and fourth digits, and the *f. hallucis* the first digit alone. In all the anomalognatous zygodactyle birds (all of which lack the *ambiens* and accessory femoro-caudal muscles) namely the Picidae, Capitonidae, and their allies, Bucerotidae and Galbulidae, an entirely unique

arrangement is found; for in those birds the *f. hallucis* splits up into three parts, supplying the second, third, and fourth digits *as well as* the first one (*hallux*), whilst the *f. perforans* is distributed to the third digit alone.

Another set of interesting muscles are those belonging to the organ of voice, in connection with which they will be considered.

It would take us too much space, should we account for all the various modifications of the digestive system, especially because we do not yet understand its development nor the taxonomic value of the modifications; we do not know what is essential, what accessory, what original, and what derivative. For not only do we find extreme differences in the structure of the intestines between very closely allied forms in cases where the disagreement can be accounted for by the difference in the diet, — as in the sage-cock (*Centrocercus urophasianus*), with its thin-walled stomach, in contradistinction to the structure of the same organ in the other members of the family, as first pointed out by Mr. Ridgway, — but radical structural differences obtains often in two closely allied species, the habits and food of which are not known to differ at all. A striking example is the structure of the stomachs of the American and the African anhingas (*Plotus anhinga* and *levaillantii*), as demonstrated by Prof. Garrod. In the former, the proventriculus, instead of forming a zone or path, is developed into a special sac-like diverticulum, which projects from the gizzard externally in a way quite unlike that of any other bird. Moreover, the pyloric compartment develops a covering of hairs, a peculiarity only found in one other bird, viz., the turkey buzzard, and Prof. Forbes remarked that “this very extraordinary stomach is certainly, as far as yet [1881] known, unique amongst birds.” The African species has a stomach considerably different from that described above, as the proventriculus forms no gland-pouch, but simply two separate patches. A well-developed and hair-clad pyloric compartment is present, as in the former, but “the hairy epithelium surrounding the pyloric orifice is produced into a considerable conical, hair-covered process, projecting into the second stomach, and evidently acting as a valve to close the pylorus when necessary.”

Similar differences occur also among the pigeons, of which the genus *Ptilopus* has the gizzard provided with “four crushing-pads, instead of two, as in all other birds, including even *Treron*.” Of the genus *Carpophaga*, two species, *latrans* and *goliath*, have the epithelial lining of the gizzard developed into a number of bony conical processes, like the spines of certain sea-urchins, while no other species of the genus are known to show any trace of such a structure.

The birds are the first class of existing vertebrates with a complete double circulation, a four-chambered heart, with two entirely separate halves, and a blood of a temperature considerably higher than that of the surrounding atmosphere, ranging as it does from 100 to 112° Fahr. We say “existing vertebrates,” for there seems to be reason to suppose that the Pterosaurians, the remarkable extinct group of flying reptiles, also had hot blood, and we said “considerably higher than that of the surrounding atmosphere,” because there are well-known examples of fishes and reptiles, the temperature of which is higher than the medium they live in, though not to such a degree as in birds and mammals. Only a single permanent aortic trunk carries the blood from the heart, not two as in reptiles; but contrary to what takes place in mammals it is the right aortic arch which remains. Of special interest is the arrangement of the carotids, which carry the arterial blood to the head and neck, since their arrangement is widely different in different birds. Without going into detail we may say that the chief difference consists in the absence or presence of the right carotid.

The comparatively smaller number of birds possess the original arrangement of two distinct carotids, one right and one left, since in all the *Passeres* and a number of other groups the left only is preserved, which, however, branches off before reaching the head, thus performing the duty of both carotids. So radical this difference may seem at first sight, so unreliable are the characters furnished by it as indicating relationship, that it is altogether out of the question to use it as a means of primary division. For, while it is true that all *Passeres*—that is to say, all that have been examined, and many are still to be investigated—have only the more specialized arrangement indicated by the presence of the left carotid only, we find in other groups nearly related forms, with one or two carotids, as, for instance, among the auks, the parrots, and the herons. In nearly all birds the crural artery is derived from the sciatic, and the chief vein of the legs, the femoral; and only in a few passerine forms, the *Pipras* and the *Cotingas*, is the artery of the thigh formed by the femoral artery. During incubation the vessels of the abdominal wall dilate enormously, forming the so-called brood-organ. The blood corpuscles of birds are, on the average, of a size twice those of man, and the shape of the red ones is oblong as are those of reptiles, while in most mammals they are round.

Very characteristic, though not absolutely peculiar to birds, as we have seen above, is their pneumacity, several of their bones being hollow, and connected by openings with air-sacs, which again communicate with the lungs; by this, air is distributed all through the body, even to the interior of the bones. The enormous importance of this feature to creatures destined to inhabit the air will be readily understood when we learn that a bird with a specific gravity of 1.30 may have this reduced to only 1.05 by pumping itself full of air. The lungs themselves are two rather large sacs wedged in around the vertebræ and the heads of ribs, not free, nor enclosed in a pleura, as in mammals. The voice of birds is generally thought not to be formed in the larynx, as it is in mammals, but in a separate, and to the class quite peculiar, "lower larynx," the so-called syrinx, usually situated at the lower end of the trachea, or between it and the bronchi, though the correctness of this view concerning the formation of the voice has been recently seriously questioned. The syrinx consists of a modification of the cartilaginous and coalescent rings, forming a tympanic chamber, in the middle of which occurs a vertical membranous fold, the free edge of which is called the semilunar membrane, while on each side is attached another free-edged membrane; the voice is formed by the air causing these membranes to vibrate when forced out through the slits between the central and the lateral membranes. Intrinsic muscles run from the trachea to the bronchial rings, and are supposed to serve in varying the tension of the membrane. The peculiar arrangement of these muscles, and their importance to systematic ornithology, will be more fully treated of under the introduction to the order *Passeres*. The syrinx is not absent in any known bird, though somewhat rudimentary in some *Struthious* birds, and still more so in some of the *Cathartidæ*.

The anatomical investigations of later years have added very little to our knowledge of the neural system of birds and of the organs of sense, having been directed mostly to those features which seemed to promise greater results in the study of the affinities, the morphological development, and the systematic arrangement, thus leaving nothing of general interest to be added to what is contained in the ordinary text-books.

There is another question which is just now occupying the studies and thoughts of ornithologists, and which therefore cannot be passed by in the present work, namely the question of the migration of birds.

Taking it for granted that all our readers know what is understood by the migration of birds,—the regular travel towards the north in spring, and the regular return in fall towards the south, of certain birds,—and also what is understood by the term a permanent resident, we will at once remark that there is no fundamental difference between the categories, since perhaps the greater part of the permanent residents travel about more or less extensively during the cold season, and the range of migration of many so-called migrating species is very limited, while not a few are residents in one country, though migrating in other localities, as for instance, the meadow lark, the purple grackle, the bluebird, etc. A moment's reflection will therefore convince us that the migrating state has developed in originally sedentary birds.

The next thing to take into consideration is the fact that it is not the cold that drives the migratory birds away in fall, since other birds equally equipped stand the climate very well, and remain in the country the migrants left; the only reason why the latter go is because they are in some way or another deprived of the special food upon which their existence depends. The fact is simply that they have the choice either to go or to starve. It is also clear that they will generally not go farther than is absolutely necessary. The residents, on the other hand, are able to stay, because their principal food is to be had at all seasons in the region where they are born.

It is furthermore evident, from what daily experience teaches us, that no life-sustaining possibility is left unoccupied by nature, so that when she opens a new field where a living can be made, there the invitation to immigrate is at once accepted. Birds organized like those of which we said above that the approaching winter gives them the choice between going away or starving, but which only go so far as barely necessary, would be the first ones to avail themselves of the abundance of food in their old quarters with the returning summer. A conjectural case will help to elucidate the above remarks. Suppose, then, that the bluebird originally inhabited a great area having a uniform climate enabling the individuals throughout the range of the species to find their food all the year round, they would then be sedentary over the whole area. Suppose the climate became gradually colder in winter at the northern border, suspending insect life during a part of the year. Those living in that region would have to go or starve, and it cannot be doubted that those going in the right direction—viz. southward—and they only, would survive, while the rest would be killed. The next year the survivors will return and breed, and again only the travelers going south will save their lives. We can now understand how a migratory habit might originate; and as we know that habits easily become hereditary when necessary for the preservation of the species, we are compelled to concede that the so-called “instinct of migration is nothing but a hereditary habit forced upon certain kinds of birds by ‘natural selection.’”

But it will be seen that the result may be the same if we reverse our conjecture, and suppose that a bird—for example, the nightingale—originally inhabited a rather restricted area, which subsequently became extended for a part of the year, the summers of the adjacent territory gradually becoming inhabitable; the result would be the same.

The theory, thus far, looks acceptable; the question is now whether sufficient evidence can be had to make it probable that such conditions as those supposed above have actually existed, in answer to which I shall quote the following from Professor J. A. Allen's pen: “In reference to this point, let us revert for a moment to the geological history of North America. Nothing is doubtless more thoroughly estab-

lished than that a warm-temperate or sub-tropical climate prevailed, down to the close of the tertiary epoch, nearly to the northern pole, and that climate was previously everywhere so far equable that the necessity of migration can hardly be supposed to have existed. With the later refrigeration of the northern regions, bird life must have been crowded thence toward the tropics, and the struggle for life, therefore, greatly intensified. The less yielding forms may have become extinct; those less sensitive to climatic change would seek to extend the boundaries of their range by a slight removal northward during the milder intervals of summer, only, however, to be forced back again by the recurrence of winter. Such migration must have been, at first, incipient and gradual, extending and strengthening as the cold wave receded and opened up a wider area within which existence in summer became possible. What was at first



FIG. 6. -- Diagram showing the main migrating routes of the littoral (except fluviolittoral) birds in Europe. marine- and submarine-littoral migrants, e.g. the razor-bill and the divers. pelago- and glacial-littoral migrants, e.g. the common eider and the king eider.

a forced migration would become habitual, and, through the heredity of habit, give rise to that wonderful faculty we term the instinct of migration."

While we thus feel justified in accepting the theory as applicable to North America, similar evidence can be had from the Old World, only that the phenomenon here is somewhat different, and more conformable to the second supposition mentioned above. It is probably safe to say that northern and central Europe during the glacial period were inhabited by few if any birds, while most of those which now live there were crowded together in the warmer regions to the south of the Alps. They have consequently immigrated to their present home from the south, gradually, as the ice receded and the summers made the countries inhabitable, but were

driven back every winter when the cold reduced the insect-life, and covered the fields with snow and the waters with ice.

We are now prepared to accept the theory that the regular habit is due to 'natural selection' caused by the forced immigration or emigration according to change of climate during earlier geological periods.

Here is an appropriate place to consider for a few moments a painstaking work, which started a new era in this branch of ornithology, viz., the book "On the Migrating Routes of Birds," by Dr. J. A. Palmén, the genial Finnish zoologist. Earlier authors had been aware that some birds followed well-defined and rather narrow paths while traveling to or from their summer homes, and Professor Sundevall had already in detail laid down the route of the common European crane (*Grus grus*); but not before 1874, when Palmén published his book, was it made evident that most migrating birds travel along geographically defined routes which do not follow one

single direction of the compass, and that the birds usually do not travel in the region lying between these high-roads. He furthermore demonstrated that the routes of the water-birds chiefly follow the coast, or, where they cross the continents, along the large inland watercourses, and admirably mapped the Old World routes of the "littoral migrants," as he termed them, the preceding chart (Fig. 6.) giving an idea of the plan.

Looking at this map, two features strike us at first as difficult to understand, viz., the distinct routes across the open ocean,—for example, the routes *A*, *B*, and *X*, as also the crossing of the Mediterranean at certain points,—which, besides, are not always the shortest distance between the two continents. We might also think it strange that marine birds should go inland as indicated by the routes *C* and *D*.

In order to explain this, we have again to go back to an earlier geological period,—in fact, to the time when the migration originated. In regard to the first kind of routes—those across the open ocean—we can do nothing better than transcribe Wallace's remarks, which are as follows:—

"Migrations of this type probably date back from at least the period when there was continuous land along the route passed over; and it is a suggestive fact that this land connection is known to have existed in recent geological times. Britain was connected with the continent during, and probably before the glacial epoch, and Gibraltar, as well as Sicily, and Malta, were also recently united with Africa, as is proved by the fossil elephants and

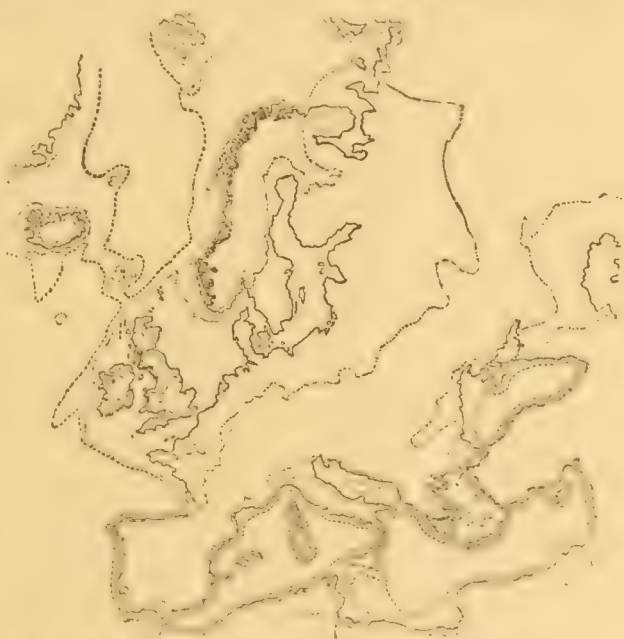


FIG. 7.—Diagram showing the depth of the seas surrounding Europe. . . . is the 100 fathom line, ——— is the 500 fathom line. The areas on the present land included within the dotted line were submerged at no time during the glacial period.

other large Mammalia found in their caverns, by the comparatively shallow waters still existing in this part of the Mediterranean, while the remainder is of oceanic profundity, and the large amount of identity in the species of land animals still inhabiting the opposite shores of the Mediterranean. The submersion of these two tracts of land would be a slow process, and from year to year the change might be hardly perceptible. It is easy to see how the migration that had once taken place over continuous land would be kept up, first over lagoons and marshes, then over a narrow channel, and subsequently over a considerable sea, no one generation of birds ever perceiving any difference in the route."

The distribution of land and water, as alluded to by Wallace, is indicated on the accompanying sketch-map (Fig. 7.) by the dotted lines which represent the 100 and 500 fathom lines; a comparative glance upon the two maps obviates any further explanations of the routes *A*, *B*, and *X*. The conclusion is obvious that the oceanic routes

indicate the ancient coast-lines along which the birds originally migrated, and furthermore, that they show the ways by which the species immigrated into the countries where they now pass the summer.

This conclusion, however, is also applicable to the land routes *C* and *D*. The geological history of that part of the earth shows most conclusively that the great Russian and the central European low-lands, during a not very distant period, geologically speaking, were submerged, forming the bottom of a rather shallow sea, the shores of which, at different times, are well indicated by the lines alluded to. Even when crossing the continents, the migrating routes of marine birds indicate ancient coast-lines, and the immigration-road of the species inhabiting the north. We note how closely these results agree with those arrived at above, where theorizing about the origin of the migrating habit.

Having thus accounted for the theory as first proposed by Palmén, and nearly simultaneously by Wallace, it remains to be shown how the birds are enabled to find their way, often thousands of miles. We need not assume a miraculous or imperative instinct, nor a sixth sense, nor the influence of terrestrial magnetism, in order to explain the remarkable fact that small birds travel over large continents and vast seas twice a year to and from the very spot where they were born. Practice is the mysterious agent, though not only the practice of the individual, but the practice of the species, the accumulated practice of thousands of generations, originating and strengthening the faculty of orientation. "It is an ascertained fact" says Wallace, "that many individual birds return year after year to build their nests in the same spot. This shows a strong local attachment, and is, in fact, the faculty of feeling, on which their very existence probably depends. For were they to wander at random each year, they would, almost certainly, not meet with places so well suited to them, and might even get into districts where they or their young would inevitably perish. It is also a curious fact that in so many cases the old birds migrate first, leaving the young ones behind, who follow some short time later, but do not go so far as their parents. This is very strongly opposed to the notion of an imperative instinct. The old birds have been before, the young have not, and it is only when the old ones have all or nearly all gone, that the young go too, probably following some of the latest stragglers. They wander, however, almost at random, and the majority are destroyed before the next spring. This is proved by the fact that the birds which return in spring are as a rule not more numerous than those which came the preceding spring, whereas those which went away in autumn were two or three times as numerous. Those young birds that do get back, however, have learnt by experience, and the next year they take care to go with the old ones."

Taking into account the "inherited talent for geography," as Weissmann happily styles it, with which every migratory bird is born, and remembering that the birds, when traveling, fly very high, and consequently overlook a great distance of their route, taking a 'bird's-eye view' of the country spread out beneath them, their performance is scarcely more wonderful than is that of the pilot who safely guides the vessel for hundreds and hundreds of miles along rocky shores and islands, all of which seem identical and indistinguishable to the inexperienced passer-by; or more admirable than the infallibility with which the Indian finds his way back, even if he has passed that way but once, through an endless forest of trees, which to any of us seem to be absolutely alike.

LEONHARD STEJNEGER.

SUB-CLASS I.—SAURURÆ.

ORDER I.—ORNITHOPAPPI.

In 1861 Hermann von Meyer, the distinguished palæontologist, described a bird's feather found in the lithographic slate of Solenhofen, in Bavaria, belonging to the upper Jurassic deposits. To the bird revealed by this feather, he gave the name of *Archæopteryx lithographica*. The discovery was received with some incredulity, but doubts were soon dispelled by Professor Owen's memoir in 1863. Herein he described a slab found in the same deposits, which showed with remarkable clearness the hind-quarters of the bird, which he rechristened *Griphornis macrurus*, a name he afterwards abandoned. The pelvis, the legs, and the long tail furnished with feathers, were splendidly preserved; but, except the wing feathers, which were disordered, and some loose and dislocated bones belonging to the anterior extremities, all the rest of the skeleton was wanting.

In 1877 another slab was found, containing a second example of *Archæopteryx*, which in many respects supplemented the other, as it is nearly or quite complete, showing the head, the vertebræ, ribs, and fore extremities, while the hind parts are in a less satisfactory condition. The first specimen was bought by the British Museum in London, while the second one was secured by the museum at Berlin, Germany; both have been examined with the utmost care by men like Richard Owen, Carl Vogt, Professor Marsh, and Dr. Lütken, and from their descriptions the present account has been compiled. The second specimen is shown in our plate.

This bird is of the greatest interest on account of its age and its remarkable structure; for not only is it the oldest bird known, although the first types of this class may be expected to have originated as early as paleozoic times, but its wonderful state of preservation enables us to throw light upon the history of the reptiloid ancestor's development into a feathered and flying bird, since in view of late discoveries it cannot be denied that we have here one of the "missing links" between the two classes, though *Archæopteryx* may still be regarded as belonging to the ornithic side of the boundary.

The first specimen was about as large as a crow, or a peregrine falcon; the second one is considerably larger, which may be due to sex; but I should not be surprised if they turned out to be two different species, as suggested by Professor Seeley, the Berlin specimen having relatively longer digits, forearm, and legs, with proportionally shorter feet.

Carl Vogt remarks that the head is small, pyramidal, the top nearly flat, the occiput obliquely truncated, and the orbits large. Both he and Professor Marsh found teeth actually in position, apparently in the premaxillary, as they are below or in front of the nasal aperture. The form of the teeth, both crown and root, is very similar to the teeth of *Hesperornis*, one of the toothed birds of the cretaceous formation. The fact that some teeth are scattered about near the jaw would suggest that they were implanted in a groove. No teeth are known from the lower jaw, but they were probably present.

The presacral vertebræ, apparently twenty-one in number, are all, or nearly all, biconcave, resembling in general form those of *Ichthyornis*, another cretaceous

bird. The sacral vertebrae are fewer in number than in any known bird, those united together probably less than five.

One of the most remarkable features of the *Archæopteryx* is the length of the tail, which is as long as the rest of the body, consisting of twenty or twenty-one long and thin vertebrae, exactly as in the reptiles, and widely differing from all other known birds. It is in reference to this unique structure of the tail that the sub-class has been named Saurura, or lizard-tailed birds.

Professor Marsh has been able to determine the presence of a single broad plate, constituting the sternum, which he thinks probably supported a keel, as the scapular arch, with its distinctly avian furculum, strongly resembles that of modern birds. The ribs are very fine, thin, curved, and pointed at the end like surgeon's needles, and show no flattening nor uncinate processes, according to Vogt; but Dr. Lütken thinks that he observed a trace of these processes, though admitting that the ribs are remarkably thin, and unlike those of other birds.

The arm proper is truly avian. Only one carpal bone seems to be present, but with that exception the hand is just what may be seen in embryonic birds of to-day, the three metacarpals being absolutely free, as in reptiles. When describing the first specimen, Professor Owen assigned four digits to it. The new one shows that this was erroneous, as it has only three long, slender digits, armed with claws, hooked and sharp-edged, on each hand; the radial digit, or the pollex, is the shortest; the other two are nearly equal, the second slightly the longer. The pollex is composed of a short metacarpal, a pretty long phalanx, and of a terminal claw-bearing phalanx; the other two digits have, besides the metacarpal, three normal phalanges. The pollex was free, like the other two digits.

One of the most interesting results of Professor Marsh's study of the London specimen is the determination of the separate condition of the pelvic bones, which, in all other known adult birds, recent and extinct, are firmly ankylosed, while in the young birds and in the Dinosaurians they are distinct.

The thigh and leg bones do not present any peculiarity worthy of our attention in the present connection, except that the distal end of the fibula stands in front of the tibia, as in *Iguanodon*, but contrary to the condition in the birds. The feet do not differ essentially from those of living birds, though deep grooves between the three elements of the metatarsus seem to indicate that the metatarsals of the second, third, and fourth toes were distinct, or, at least, only imperfectly united.

There remain the feathers, which, no doubt, are true bird's feathers, with a median shaft, having barbs perfectly formed.

The remiges of the wings are fixed to the ulnar edge of the arm, and to the hand; they are covered for nearly half their length with a fine filiform down. None of them project beyond the others; the wing is rounded in its outline like that of a fowl. It is possible that at the base of the neck there was a ruff, like that of the condor. Some traces of it are perhaps visible. The tibia was clothed with feathers for the whole of its length. The *Archæopteryx* thus wore breeches, as do our falcons. Each caudal vertebra bore a pair of lateral rectrices, an arrangement totally different from that of all other known birds.

All the rest of the body—the head, neck, and trunk—were apparently naked and unprovided with feathers, for no traces of either down or feathers are there to be seen; but it must be remembered that the specimen may have been completely decomposed before imbedded, and the small feathers or down carried away, while the larger

ones only adhered to the skeleton. The theory of the nakedness of the body, as advocated by Professor Vogt, is not very probable, in view of the fact that the thighs were feathered; and to suppose that the rest of the body was scaly is hardly defensible, for we may with greater right ask where the scales are than where the feathers.

The conclusion we gain from the above is that the oldest bird known was a land-bird, and arboreal in its habits. But in spite of its feathers it can hardly have had a great resemblance to the forms which now inhabit the woods. Nor is it probable that it was a very expert flyer; the broad, rounded wings and the curious tail suggest a locomotion of a somewhat similar nature to the 'flight' of the flying squirrel, the tail of which in fact strikingly recalls that of the *Archæopteryx*.

There have been and still are authors who regard this animal as a reptile, but apparently with no good foundation. If we accept the theory that the birds have developed from the reptiles, the transition must have been gradual and nearly imperceptible, so that the line to be drawn between the two classes must be more or less artificial. But if we do not accept a feathered and warm-blooded vertebrate as a bird, where then is the criterion to distinguish it from a reptile?

The *Archæopteryx* was long the only Jurassic bird known. In addition to his many other discoveries of fossil birds, Professor Marsh has of late added that of an American Jurassic bird, from the *Atlantosaurus*-beds of Wyoming, a form which in 1881 he described as *Laopteryx priscus*. The most important specimen is the posterior portion of the skull, indicating a bird rather larger than a great blue heron. Professor Marsh remarks further that in its main features the type specimen resembles the skull of the *Ratitæ* more than that of any existing birds. In the matrix attached to this skull a single tooth was found, which most resembles the teeth of birds, especially those of *Ichthyornis*; and Marsh thinks it probable that it belonged to *Laopteryx*, and that this bird also possessed biconcave vertebræ. Like *Archæopteryx*, it was a land-bird.

It would be futile to attempt a reconstruction of the whole bird from the few remnants on the old Cuvierian plan, since modern discoveries have proved the utter failure of the method. Nobody can tell how the tail of *Laopteryx* was formed, and when we place it with the *Saururæ*, we do so because that position is as good as any other, and because its geological age probably corresponds to that of *Archæopteryx*.

LEONHARD STENEGER.

SUB-CLASS II. — ODONTOTORMÆ.

ORDER I. — PTEROPAPPI.

With the exception of the Solenhofen bird, only a few scattered remains of fossil birds, save from the most recent deposits, had been found prior to those startling discoveries which afterwards were figured and described in Professor Marsh's famous monograph on the extinct toothed birds of North America. Not only were the remains of these cretaceous birds in an unusually splendid state of preservation, but they reversed in many respects both the popular and the scientific ideas as to the characters and the origin of birds.

As these *Odontornithes*, or toothed birds, form one of the most interesting and important contributions to modern ornithological science, and as a thorough understanding of their remarkable structure, so different from that of any living bird, is

necessary in order to obtain an intelligent idea of the state of that science, and of the class it treats of, a full account of these ancestors of the feathered tribes has been deemed desirable, and, as Professor Marsh's work is the only source of information, the following statements are given as nearly in his own words as possible.

The geological horizon of the known Odontornithes is in the middle cretaceous, and corresponds to the strata named by Marsh the 'Pteranodon beds,' situated along the eastern slope of the Rocky Mountains, and especially on the adjoining plains in Kansas and Colorado. These beds consist mainly of a fine yellow chalk and calcareous shale, both admirably adapted to preserve delicate specimens. The first bird fossil discovered in this region was the lower end of the tibia of *Hesperornis*, found by Professor Marsh in December, 1870, near the Smoky Hill River, in western Kansas. In June, 1871, he made the discovery of the skeleton which forms the type of *H. regalis*. In the autumn, 1872, another skeleton of the same was found, and the type of the genus *Apatornis*. The fossil birds procured in that region between 1870 and 1880, by the different explorations, include remains of more than one hundred individuals of the toothed birds.

It was soon found that these toothed birds were of two different kinds, which, although united under the common heading, Odontornithes, were more different than almost any two living birds of the present day, and which had very little in common



FIG. 8. — Quadrate bone of *Ichthyornis*.

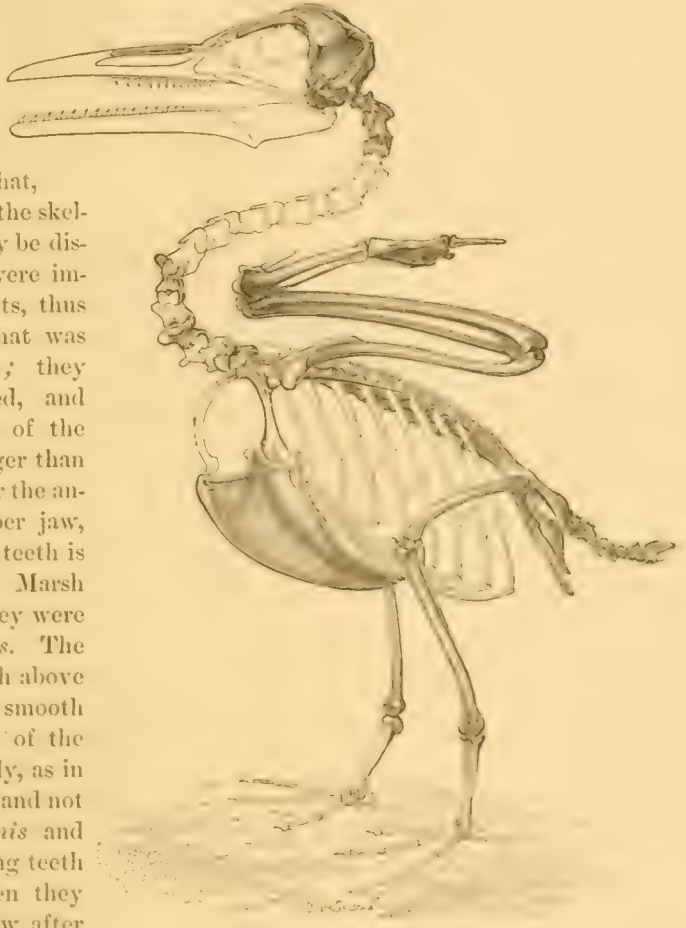
save the teeth. But even these were extremely different, being placed, as they were, in a continuous groove in one group, while in the other they were implanted in individual sockets. The former were therefore styled Odonto-

holeæ (from the Greek *odontoi*, teeth, and *holkos*, a groove) while the others received the name Odontotormæ (*odontoi*, and *tormos*, a socket). The latter form the subclass here under consideration.

The Odontotormæ, or birds with teeth in sockets, so far as now known, were all of small size, and possessed powerful wings and very small legs and feet. Some of their characters—as, for instance, their vertebrae, biconcave or hollow both behind and in front—separate them widely from all birds recent and extinct.

The remains of this group preserved are more or less pneumatic, and this fact, in connection with their small size, is perhaps the main reason why so few have been discovered. As might naturally be expected, the hollow bones of flying birds, being filled with air, enable the carcass to float upon the water much longer than it otherwise would, and it is thus liable to be destroyed by fishes or other animals. Hence, the chances of complete skeletons being buried entire are greatly diminished. The plains east of the Rocky Mountains have yielded remains of not less than seventy-seven different individuals of Odontotormæ, belonging to two well-marked "genera," *Ichthyornis* and *Apatornis*, the former represented by several species (some of which were formerly referred to the genus *Graculavus*), and the latter by only one. These were all small birds, scarcely larger than a pigeon. In their powerful wings and small legs and feet, they remind one of the terns, and, according to present evidence, they were aquatic birds, of similar life and habits.

The skull was very large in proportion to the rest of the skeleton, the disproportion being well shown in the accompanying cut, Fig. 9. The cranial sutures were nearly obliterated. The quadrate bone, as shown in Fig. 8, has only a single facet on its articular head, agreeing in that respect with *Hesperornis* and the Struthionine birds. The brain was small, and, like that of *Hesperornis*, which it resembles more nearly than that of any other known bird, in its main features strongly reptilian, as in the elongated form and the prominent optic lobes. The two rami of the lower jaw were entirely separate, having been united in front only by cartilage, and the tooth-bearing portion is so similar to that of some of the smaller Mosasauroid reptiles that, without other portions of the skeleton, the two could hardly be distinguished. The teeth were implanted in distinct sockets, thus differing widely from what was the case in *Hesperornis*; they were all sharp, pointed, and strongly recurved, those of the upper jaw apparently larger than the lower ones. Whether the anterior portion of the upper jaw, the premaxilla, contained teeth is uncertain, but Professor Marsh thinks it probable that they were absent, as in *Hesperornis*. The whole surface of the tooth above the jaw was covered with smooth enamel. The succession of the teeth took place vertically, as in crocodiles and Dinosaurs, and not laterally, as in *Hesperornis* and the Mosasaurs. The young teeth were much inclined when they first appeared above the jaw, after the old teeth had been expelled.

FIG. 9. — Restoration of *Ichthyornis*.

The presacral vertebrae were more remarkable than those of any other known bird except *Archaeopteryx*, for they were not saddle-shaped, but biconcave as shown in Figs. 10, 11, which show clearly the cup-shaped articulation of the centrum. However, the third vertebra of the neck, but no other, presents a modified form (Fig. 12), evidently produced by the necessity of providing for an easy vertical motion of the neck at its first bend. The tail is remarkable for being of the same type as is that of all modern birds, namely, comparatively short, and the last vertebrae ankylosed into a pygostyle.

The fore extremities, including the shoulder girdle, were, so far as known, essen-

tially as in living birds, as apparently was the sternum also. Of the clavicles only a fragment of the upper end has yet been found. The wings clearly indicate very strong power of flight. The humerus had an enormous radial crest, surpassing in comparative size that of any living bird, and was placed in a plane nearly parallel with the long axis of the head of the humerus, instead of considerably inclined, as in most birds, thus strongly resembling, in these two points, the humerus in the pterodactyls, the extinct flying reptiles. The carpal bones were two in number, and the metacarpals united as usual; a noticeable feature of the second finger is that the thin lateral expansion of the first phalanx ends in a prominent flattened, hook-like process beyond the rest of the bone.

The pelvic arch exhibits some interesting reptilian characters. The sacrum consisted of about ten vertebrae thoroughly ankylosed, as were also the pelvic bones. Of these the ischium was expanded in the middle, extended further back than the ilium, and was not united with the latter posteriorly, agreeing in that respect with *Hesperornis* and a few modern reptilian birds. The legs and feet do not differ more from those of modern birds than did the wings. The metatarsals are ankylosed firmly and present no peculiar features. The phalanges, with the exception of one, have not yet been found.

That *Ichthyornis* was provided with feathers is proved beyond question by the tubercles for the attachment of quills on the forearm. It will thus be seen that *Ich-*



FIG. 10.



FIG. 11.



FIG. 12.

Vertebrae of *Ichthyornis*.

thyornis, "the fish-bird," as it is fitly called from its fish-like vertebrae, was a remarkable combination of very old and very modern characters, biconcave vertebrae and large head with separate lower jaw and teeth, in connection with ankylosed metacarpals and metatarsals. Referring to the accompanying cut (Fig. 9), which represents Marsh's restoration of one of the species, for information concerning the general aspect of the bird, we may remark, however, that the missing parts are supplied from a tern, a rather specialized modern bird, and that consequently many features of the restoration are unreliable, while one, at least, is manifestly incorrect. For we may safely assume that *Ichthyornis* was holorhinal like *Hesperornis*, and not schizorhinal like a tern, as represented in the figure, and it seems rather strange that the head has been restored after the fashion of the latter, when it is admitted that it resembles that of the former "more nearly than that of any other known bird." We may, perhaps, also take exception to the restoration of the neck, as not in harmony with the disproportionate large head.

The gap between *Ichthyornis* and all other birds is very great, so it would be quite unsafe to advance any opinion as to its genesis and relationships. All that we can say at present is, that it sprung very early from the ancestral stock, preserving the primitive character of the vertebrae and the skull long after other parts had reached an advanced specialization, thus adding new evidence to the principle, "that an animal may attain great development in one set of characters, and at the same time retain other low features of the ancestral type."

SUB-CLASS III. — ODONTOHOLCÆ.

ORDER I. — DROMÆOPAPPI.

Contemporaneous with the *Ichthyornis*, other toothed birds of quite different aspect and characters inhabited the same cretaceous sea which then covered the central and western parts of our continent. The former went hovering over the waters, darting, like the terns and gulls of the present day, upon the unfortunate fishes which came too near the surface; while the type of the present sub-class, the *Hesperornis*, or 'the western bird,' as that name literally means, followed the prey to the very bottom of the sea, in diving power and speed surpassing any other bird, living or fossil, and even more fitted for aquatic life than the penguin, as it had no wings whatsoever, and its feet were so specially modified for propelling their large bodies through the water that they could hardly move on land. We will further on have opportunity of characterizing the penguins as the seals among the birds: *Hesperornis* and its allies represent the dolphins.

It is most fortunate for science, Professor Marsh remarks, that *Hesperornis regalis* — with the exception of *Archæopteryx* and *Luopteryx*, the oldest bird known — should now be represented by remains as complete as any fossil skeleton yet discovered, even in the later formations, as nearly all the bones of the specimens obtained, when first found in the matrix, were almost as perfect as in life; and the various remains belonging to about fifty different individuals of *Hesperornis* are now in the museum of Yale College.

With a general superficial resemblance to that of a loon, the skull of *Hesperornis*, in its more important characters, approaches that of the Struthious birds, being like the latter dromæognathous, and having, like them and *Ichthyornis*, only one facet on the articular head of the quadrate bone. The nostrils are holorhinal. The brain-case is small, and its sutures entirely fused together. As in *Ichthyornis* and many recent water-birds, well-marked glandular depressions extend along the roof of the orbits. The premaxillaries were elongated, forming a long, pointed beak, which in front of the nostrils was apparently covered with a horny sheath, as in modern birds. There were no teeth in these bones, as in the upper jaw they were confined to the maxillary bones, which were armed with (in *H. regalis* fourteen) teeth set in a deep, continuous groove, with only faint indications of separate sockets. The lower jaw was thickly set with teeth to the end (in *regalis* thirty-three), and the two halves were separate, as in *Ichthyornis*, only united in front by ligament. The teeth, which are so reptilian in their characters that nobody would hesitate to refer them to that class, had they been found alone, were gradually replaced by successional teeth, the germ of the young tooth growing in a pit made in the old one by absorption, thus undermining and at last expelling the latter (Fig. 13).

In strange contrast to *Ichthyornis*, the present group of fossil birds had vertebrae resembling in their more important characters the corresponding vertebrae of existing



FIG. 13. — Tooth of *Hesperornis*, enlarged; c, germ of second tooth.

birds. Their number was about forty-nine, a high number for the class; but the most interesting part of the vertebral column is undoubtedly the tail, which was composed of the great number of twelve vertebrae. The middle and posterior ones had very long and broad transverse processes, which restricted lateral motion, clearly indicating that the tail was mainly moved up and down, evidently as an aid in diving, the lateral

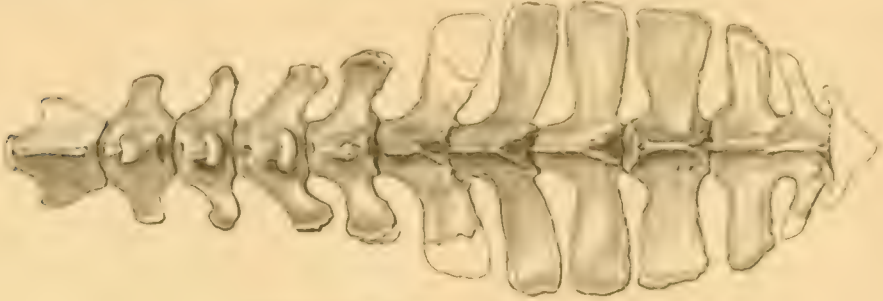


FIG. 11. — Caudal vertebrae of *Hesperornis*.

motion being confined to the tail as a whole, and performed between the foremost vertebrae. The last three or four caudals were firmly fused together, forming a flat plate, analogous to, but quite unlike, the ploughshare bone of modern birds. Thus the tail formed a sort of an oar, similar to a beaver's tail (Fig. 14).

The shoulder girdle, in its retrograde development, is particularly interesting as showing strong resemblance in many respects to that of the existing dromæognathous birds, especially when we remember that *Hesperornis* itself had a palatal structure of a similar type; for not only is the sternum devoid of a keel, but the long axes of the



FIG. 15. — Scapular arch of *Hesperornis*, reduced.

adjacent parts of the scapula and coracoid were parallel, or identical, as shown in the accompanying cut (Fig. 15). The breast bone was thin and weak, with a rounded mesial projection in front, corresponding to the manubrium; the posterior margin was quite thin, and had two shallow emarginations. The ribs show only little difference from those of modern birds, and some of them supported uncinate processes. The clavicles were separate, resembling the corresponding bones in the embryos of some modern forms. The coracoids and

the scapula were quite small. The wing is represented by the rudimentary humerus alone, the other bones having become atrophied.

The pelvis, though in its general form resembling that of *Colymbus*, exhibits many features common to that of reptiles, and of several dromæognathous living birds. Most interesting, perhaps, is that the condyloid cup of the hip-joint is closed by bone, except a foramen that perforates the inner wall, entirely unlike the acetabulum of other birds, but resembling that of the crocodiles. The three constituents of the pel-

vis, which are firmly fused together, have their posterior extremities free, as in the emu and in *Tinamus*.

As the legs of the ostriches have been extremely modified, in order to adapt them for swift movements on terra firma, so were those of *Hesperornis* specialized for a life more completely aquatic than that of any known bird. Professor Marsh thinks that it might even be questioned whether it could be said to walk on land, though admitting that some movement on shore was a necessity. Considering the posterior limb as a whole, it will be found a nearly perfect piece of machinery for propulsion through the water. Provisions were made for a very powerful backward stroke, followed by a quick recovery, with little loss by resistance, a movement quite analogous to the strong stroke of an oar feathered on its return.

To a certain degree the legs of *Hesperornis* may be said to resemble those of the grebes, though the differences are both many and important. The thigh bone is shorter and stouter than in any known aquatic bird, recent or fossil, and is very much flattened transversely, being considerably broader than thick. The fourth trochanter (Dollo) is plainly visible on the figure. The leg bone is much the largest bone in the skeleton; the cnemial process rises into a powerful tuberosity above the articulation with the thigh bone. The patella, or knee-pan, is a large separate bone, perforated by a large hole for the tendon of the ambiens muscle. The second, third, and fourth metatarsals were thoroughly fused together, as in all recent birds except the penguins, but in most specimens traces of the sutures remain. The fourth metatarsal so greatly exceeded the other two in size that it forms by far the greatest part of the entire tarso-metatarsal bone. The first metatarsal was only

a mere remnant, united to the lower half of the second by cartilage. The number of toes were four, all directed forward, as in the penguins, and the number of the phalanges seems to have been normal, viz., 2, 3, 4, 5, of which the penultimate one was the longest, the phalanges on the whole being shorter and thicker than in most swimming birds. The fourth or outer toe was much the longest, being in fact the dominant one, three or four times as powerful as the adjoining middle one, or, indeed, as the other three combined; these were gradually diminishing in length to the hallux.

As to the restoration of this remarkable bird, as represented in Fig. 16, little is to be said, as only a few unimportant bones are missing, so that we here have a nearly complete representation of the entire skeleton. *Hesperornis regalis* was about six feet long, and, when standing in the position represented in our figure, would be rather more than three feet in height, thus considerably surpassing the largest pelican. It is

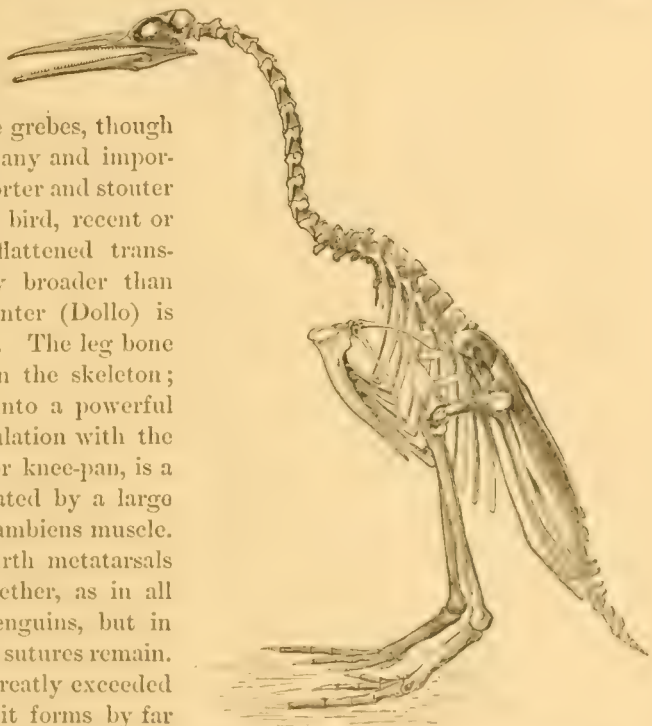


FIG. 16. — Restoration of *Hesperornis regalis*.

not difficult, with such material, to imagine, or rather to conclude, which were the leading peculiarities in the habit of that strange water-bird inhabiting the great — now fossilized — sea of the far west, many, many thousand years ago. Not being able to improve on Professor Marsh's account, we take great pleasure in introducing it here in full:—

"*Hesperornis* was a typical aquatic bird, and in habits was doubtless very similar to the loon, although, flight being impossible, its life was probably passed entirely upon the water, except when visiting the shore for the purpose of breeding. The nearest land at that time was the succession of low islands which marked the position of the present Rocky Mountains. In the shallow tropical sea, extending from this land five hundred miles or more to the eastward, and to unknown limits north and south, there was the greatest abundance and variety of fishes, and these doubtless constituted the main food of the present species. *Hesperornis*, as we have seen, was an admirable diver, while the long neck, with its capabilities of rapid flexure, and the long, slender jaws armed with sharp, recurved teeth, formed together a perfect instrument for the capture and retention of the most agile fish. As the lower jaws were united in front only by cartilage, as in serpents, and had on each side a joint which admitted of some motion, the power of swallowing was doubtless equal to almost any emergency."

If, allowing our imagination, within logical bounds, to cover the bones of the skeleton, figured above, with flesh, skin, and feathers, what a strange creature rises before our eyes! A bird indeed, but a kind of swimming, loon-like, raptorial ostrich, without fore limbs, with the gape armed with formidable rows of strong teeth like a gigantic lizard, and with a large, broad, and flattened tail like a beaver. And extremely paradoxical as is its external appearance, so is also its internal structure.

Compared with *Ichthyornis*, *Hesperornis*, on the whole, is the more specialized form as is indicated by its saddle-shaped vertebrae, its atrophied keel of the breastbone, and its rudimentary fore limbs. But several other features, on the other hand, are less developed; thus, for instance, the teeth implanted in grooves, and not in separate sockets, as well as the long tail, — characters retained from their common ancestor, which may be looked for in some older deposit than the cretaceous formation.

Most of the characters which we have mentioned as Struthionine or ostrich-like, are really only reptile-like, having the same signification among the Struthiones, though some features — for example, the arrangement of the shoulder girdle — seem to indicate a nearer relationship; that is to say, that the latter birds have sprung from an ancestral stock not very distant, allied to that strangest of all strange birds, the ancient *Hesperornis*.

The systematic position of another cretaceous bird from the Pteranodon beds of western Kansas, the *Lestornis crassipes* is pretty well established to be near *Hesperornis*. A nearly complete skeleton was found in 1876 by Mr. G. O. Cooper. This bird is considerably larger than *Hesperornis*, and is remarkable for a protuberance on the inner side of the metatarsus, which may have served as a support for a sort of rudimentary spur. Many other remains of cretaceous birds, particularly from the upper deposits, have been found and described in this country, but they are mostly too fragmentary to allow more than a guess as to their relationships, and, as hardly more than a few bones are preserved of *Baptornis*, *Laornis*, *Graculavus*, etc., it will be sufficient to mention their names. In Europe numerous remains, among which is the so-called *Enaliornis*, have been found in the cretaceous deposits, and to these the above remark is equally applicable.

LEONHARD STEJNEGER.

SUB-CLASS IV. — EURHIPIDURÆ.

Eurhipiduræ, the term applied by Gill to these birds in contradistinction to Saururæ, means 'birds provided with a normal fan tail,' and expresses very well the general feature of this sub-class, namely, a feather tail, the base of which, formed by the shafts, practically starts from a single point, spreading out at the end like a fan, notwithstanding the fact that not a few birds of this division are deprived of this 'external' tail, as, for instance, some Struthionine birds and the grebes, since this absence is only due to a retrograde development of forms which were as 'eurhipidurous' as the rest of them. More trenchant is the corresponding internal or anatomical arrangement of the caudal vertebræ. These are reduced in number, shortened, and the last ones united into a single bone, the pygostyle, the total length of the tail proper being much less than that of the rest of the body. But while these characters are also shared by the Ichthyornithes of a foregoing sub-class, the members of the present one have no biconcave antesacral vertebræ, nor teeth in the jaws.

The Eurhipiduræ embraces all the living birds, besides a number of extinct forms from the more recent geological formations, consequently all birds known to constitute the class until less than a quarter of a century ago.

SUPER-ORDER I. — DROMÆOGNATHÆ.

Two peculiarities in the anatomical structure of the birds of this group separate them at once and rather widely from the rest of the *Eurhipiduræ*, namely, the dromæognathous character of the palate, and the relations of the pubic elements, of which the ilium and the ischium are not united behind, and do not enclose a sciatic foramen as in both Impennes and Euornithes. These characters are combined with several others, and seem to us to be of more importance than the presence or absence of a keel on the sternum. The absence of that element in some forms of the present group may be due to abortion and reduction. This is the most probable explanation, though it may not be the true one. But in the latter case the birds with keeled sternum must have sprung from forms not having a keel, as we can hardly assume that Ratitæ and Carinatæ sprung from the ancestral reptilian stock independently of each other. On the other hand, there is ample proof that several Euornithes have become *nearly* keelless by reduction (*Didus*, *Notornis*, *Habroptilus*), so there seems not to be any reason why it should not be lost altogether. Again, the plumage and rudiments of rectrices in several Ratitæ (cassowary, Apteryx), strongly point towards their reduction from flying ancestors, or, to use Wallace's words, "render it probable that the Struthious birds do not owe their imperfect wings to a direct evolution from a reptilian type, but to a retrograde development from some low form of winged bird. . . . We may be sure that birds acquired wings and feathers and some power of flight before they developed a keeled sternum, since we see that bats, with no such keel, fly very well."

The Dromæognathæ, which once formed the prevailing constituents of the earth's bird-fauna, are now only few in number. Many of their members have been extinguished during the present geological period, and several are soon to follow. The present era is that of the Euornithes.

Not before the theory of evolution had become fairly established was the impor-

tance of the structural characters peculiar to this super-order clearly understood. A few impotent attempts had been made to give the Struthious birds a position in the system corresponding to their peculiarities, but most ornithologists contented themselves by conceding them rank as a "family," or, at the most, as an "order," while others adhered to the arrangement of the eighteenth century, in regarding them only as separate genera, with which they associated a few forms of somewhat similar habits and superficial resemblance, — for instance, the bustards, — in a conglomerate group, designated by the name of *Cursores*. To Huxley is due the honor of vindicating their right to be regarded as primary groups, though he failed to include the Tinamous (*Crypturi*), his *Dromæognathæ par excellence*, a name we have here adopted to signify all the dromæognathous birds with true bird tail and without teeth.

ORDER I. — STRUTHIONES.

Our knowledge of the large forms constituting the first order of living birds can hardly be said to be more than twenty-five years old. True, all the typical species were known long ago, but a more thorough examination and understanding of the group is of rather recent date. Then, only five or six species were known; now we recognize about twenty forms; their affinities, their internal and external anatomy, and partly their development, have been investigated during the last quarter of a century, and more accurate information concerning habits and nature of these birds has replaced the old yarns and fables imposed upon credulous travelers by ignorant savages. Ornithology is here bound to thankfully acknowledge the aid derived from the zoological gardens, and what has been accomplished may be taken as a fair promise of what we have to expect in the future. For if we are going to study the birds, we must study the whole animal, and not the stuffed skin alone; the feathers constitute an important and peculiar part of the bird; but the bird is also a vertebrate, and should be treated as such.

The members of this division are characterized by the great development of the hind extremities for terrestrial locomotion, hence, the legs are high and stout, and the neck is correspondingly long and slender. The bill is broad at base, depressed, not longer than the head, and the nostrils, though not placed at the extremity of the bill, as in *Apterygges*, are situated further from the base than in most other birds; the mouth is deeply split. None of the living forms have more than three toes, and some of them — the African ostrich and its nearest allies — have only two, by suppression of the third toe. It has been usually taught that the Struthiones have no lower larynx, or 'syrinx,' as the rest of the birds, but Prof. Forbes's investigation shows that this is totally erroneous, and since the mistake is still repeated in works of rather recent date, it may be useful to repeat the conclusion he arrived at, as follows: "As regards the alleged absence of a lower larynx (or 'syrinx') in these 'Ratite' birds, it is obviously untrue as regards the genus *Rhea*. In the other genera, an answer is less easy, and its nature must depend upon what is meant by the term 'lower larynx.' If the presence of semi-rings externally, and of a *membrana tympaniformis* internally, forming the walls of the bronchi, and of vocal chords developed in the interior of those tubes, be held to be sufficient to characterize a 'syrinx,' then it will be incorrect to say that the Ratite birds have no voice-organs. As I have shown, all these three structures are present, variously developed, in the genera in question, together with at least a rudiment of a *membrana semilunaris*."

The Struthionine birds are now nearly confined to the southern hemisphere, and the living forms are only the last survivors of a once numerous order, which also dominated in Europe, and probably North America, since, from the strata underlaying London, several fossil remains have been described, the so-called *Macrornis*, said to be related to the emu, and the so-called *Megalornis emuinus* of similar affinities. Also from New Mexico is a fossil ostrich known, the *Diatryma gigantea* of Cope.

It may be interesting to quote as a conclusion Mr. Wallace's ideas as to the origin of the birds in question, and how he accounts for their present disconnected distribution.

During the early period, he contends, when the great southern continents—South America, Africa, and Australia—were equally free from the incursions of the destructive felines of the north, the Struthiones, or ostrich type of birds, was probably developed into its existing forms. It is not at all necessary to suppose that these three continents were at any time united, in order to account for the distribution of these great terrestrial birds. . . . The ancestral Struthious type may, like the marsupial, have once spread over the larger portion of the globe; but as higher forms, especially Carnivora, became developed, it would be exterminated everywhere but in those regions where it was free from their attacks. In each of these it would develop into special forms adapted to surrounding conditions; and the large size, great strength, and excessive speed of the ostrich may have been a comparatively late development caused by its exposure to the attacks of enemies which rendered such modification necessary.

The ostrich—the largest, and the first to open the series of the living birds—belongs to the genus *Struthio*, which alone constitutes the family STRUTHIONIDÆ and the super-family STRUTHIOIDEÆ. A native of the plains and deserts of Africa, it has been known to civilized man since the beginning of the history of the western nations, noted for its size, its swiftness of foot, and the beauty of its curled tail and wing plumes, which, since time immemorial, have been used as signs of distinction and as ornament, therefore being the object of an important trade on the dark continent. Huge fans of ostrich-plumes belong to the attributives of the African and Oriental rulers of to-day as they did during the time of the Egyptian Pharaohs; the ladies of olden Rome prized its unrivaled feathers as highly as any slave of the present fashion, and live ostriches were among the strange animals which, nearly two thousand years ago, were exhibited to the gaze of the populace in the arenas and amphitheatres, while to-day that giant is indispensable to any menagerie or zoological garden of reputation. Hottentots and other African savages kill him for the feathers, Arabian sheiks and English tourists hunt him for sport, lions and other wild beasts kill him whenever they find an opportunity; and although the ostrich is one of the few birds deprived of the capacity of flight, yet he is not exterminated, nor is he likely to become so in a near future, for several reasons: his swiftness of foot, his great productiveness, and his recent domestication, which promises to increase the number of living ostriches by ten for each one destroyed by the repeating rifle.

The nearest allies of the true ostriches are the South American naudas, which differ from the other birds of the same order by having the wing-bones comparatively well developed, especially by a long humerus, and there being three fingers on the hand. They have also a strong ambiens muscle, which is absent in the cassowaries and emus; the gall-bladder is absent. *Inter se* the African and the American ostriches are distinguished by the former having two toes only, the third and fourth, respectively, with four and

five phalanges, the latter being clawless, thus showing a tendency to become finally reduced, as in the Solipeds among the mammals; the true ostrich, furthermore, is characterized by an external tail; by the maxillo-palatines articulating with facets on the sides of the vomer; by the pubes uniting in a ventral symphysis, while the ischia are free; by having two carotids, besides several other features.

The "camel bird," the "pride of the desert," is represented in Africa by three forms or species, the well-known *Struthio camelus*, besides the more recently described *S. australis*, from South Africa, and *S. molybdophanes* from Somali-land, though the status of the two last ones is yet somewhat doubtful. An ostrich is also known to occur in the deserts adjoining Palestine and the countries of the Euphrates valley, and is also said to inhabit Arabia proper. That it has always been called *S. camelus* does not prove that it is the same species as that of Western Africa, since the two other forms of that continent, until a few years ago, were confounded with it under the same name; it is rather probable that the Asiatic bird is separable. The differences, however, are slight and only visible to the expert. For our purpose it suffices to describe the appearance of the ostrich in general. The head, neck, and legs are naked, only covered by a sparse down; the male has black feathers on the body, those of the wing and tail being white and of the greatest value; the female is plainer colored, brownish gray, and the young birds, when two months old, are similar; the chick is covered all over with a light-colored spiny down, with longitudinal blackish stripes. The full adult plumage is assumed at the third year. The adult male stands about seven feet high, and weighs from one hundred and fifty to two hundred pounds. In habits the different forms may be nearly identical, and what trustworthy travelers have related of one species is probable applicable to the others.

The ostrich has, from olden time, been regarded as an exceedingly stupid bird, — we all remember the tale of the ostrich believing himself concealed when putting his head behind a stone so he could not see his enemy, — and Alfred Brehm has emphatically expressed the same opinion, though other observers attribute its shyness and timidity to a certain degree of intelligence. In captivity it soon becomes tame, and is said to be quite gentle, but is easily frightened so as to run insanely about in its inclosure; during the breeding season the old male is usually quite savage, and attacks even man, inflicting sometimes dangerous injuries by kicking.

Timid and of rather solitary tastes, the ostrich lives in small flocks, relying upon their extraordinarily acute sight and their fleetness of foot for safety, often in the neighborhood of the still more wary herds of wild zebras. They feed upon the low grass and herbs, when in the wild state, and occasionally some insects, a few reptiles or the like are picked up; but it is only in confinement that the ostrich proves himself that voracious omnivorous animal that has made the ostrich stomach almost proverbial.

Judging from the scanty information of travelers as to the voice of the ostrich, we may infer that, usually, it is a rather silent bird, though occasionally making good use of its rather imperfect syrinx, as seems evident from Livingstone's statement, that it is frequently difficult to distinguish its bellowing from the roaring of the lion.

In order to illustrate certain habits, and the manner in which they are hunted in North Africa, we transcribe the following from Rev. Mr. Tristram's spirited account of his experiences in that part of the world:—

"The capture of the ostrich is the greatest feat of hunting to which the Arab sportsman aspires, and in richness of booty it ranks next to the plunder of a caravan.

But such prizes are not to be obtained without cost and toil, and it is generally estimated that the capture of an ostrich or two must be at the sacrifice of the lives of two horses. So wary is the bird, and so open are the vast plains over which it roams, that



FIG. 17.—*Struthio camelus*, African ostrich.

no ambuscades or artifices can be employed, and the vulgar resource of dogged perseverance is the only mode of pursuit. The horses to be employed undergo a long and painful training, abstinence from water and a diet of dry dates being considered the best means for strengthening their wind. The hunters set forth with small skins of

water strapped under their horses' bellies, and a scanty allowance of food for four or five days, distributed judiciously about their saddles. The ostrich generally lives in companies of from four to six individuals, which do not appear to be in the habit, under ordinary circumstances, of wandering more than twenty or thirty miles from their headquarters. When despoiled, two or three of the hunters follow the herd at a gentle gallop, endeavoring only to keep the birds in sight, without alarming them or driving them at full speed, when they would soon be lost to view. The rest of the pursuers leisurely proceed in a direction at right angles to the course which the ostriches have taken, knowing by experience their habit of running in a circle. Posted on the best lookout they can find, they await for hours the anticipated route of the game calculating upon intersecting their path. If fortunate enough to detect them, the relay sets upon the now fatigued flock, and frequently succeeds in running one or two down, though a horse or two generally falls exhausted in the pursuit. The ostrich, when overtaken, offers no resistance beyond kicking out sideways. A skin in full plumage is worth on the spot from forty to one hundred Spanish dollars; but the Arabs are in the habit of judiciously thinning the feathers, so that the trader can rarely obtain a specimen on which this tax has not been paid."

The chase of wild ostriches for the sake of the feathers will soon become a thing of the past, however, since now the rational domestication of this valuable bird has proved a grand success. The natives of some parts of Africa have, in fact, been practising "ostrich farming" before white men visited them, and even used artificial incubation. We are told that tribes of Sudan, the upper Senegal, and the Algerian frontiers raise their ostriches like real poultry-yard birds. By day the birds wander about the camp in search of food, and come back again at night-fall to pass the night under the shelter of their master's tents. When the tribe is traveling, they follow faithfully along without ever turning aside, and without evincing the least desire to return to a wild life. Still this ostrich raising has been quite insignificant, and only a small fraction of the plumes in the market was due to that source, and it was first when the European—particularly English—colonists in different parts of Africa commenced that remunerative business on a grand scale, that the supply of ostrich-feathers from tame birds, bred in captivity, became considerable. A few figures will show the importance of this new branch of "stock" raising, which is hardly twenty years old, since, in 1865, the English colonies owned only eighty tame ostriches. The value of the annual yield of feathers in South Africa at the present day is estimated at about four million dollars, while in 1865 the total export (wild and tame) from the Cape did not reach one-tenth of that amount.

On an "ostrich farm" the industry is divided into two branches, that of producing feathers, and of raising young birds. From a recent report on the subject we make the following interesting extracts: An ostrich is first plucked at the age of six to eight months, and again six to nine months later, and every succeeding six to nine months. The chicken feathers are of little value, say about five dollars per bird, but the next and following pluckings realize from forty to one hundred and fifty dollars per bird. The length of time between each plucking, the weight of the feathers, and the richness of the plumage, depend partly upon what care is taken not to extract the feathers too early, thus causing injury to the wing, but more especially upon the quality of the pasturage. On good grazing land, one acre is required per bird. The best mode of plucking the feathers is not to pull them out, but to cut the quill about an inch from the root, the portion left in the wing speedily "ripens," and may in a few

weeks be pulled out with a pair of pincers, after which the new feather begins to form. Others advocate a specially constructed box in which the bird cannot move; through openings in the sides the wings are accessible, and, by a double movement of twisting and pulling the feathers are drawn.

The ostrich is monogamic, and the hen lays an egg every alternate day in the nest dug out in the sand by the male, if that hollow can be termed a nest. Ten eggs are probably the average number laid in the wild state, but in captivity the laying may be continued like that of the common fowl when the eggs are taken away as soon as deposited. On the "farm," the egg which the birds themselves cannot cover may be hatched artificially in an incubator, the result of which is illustrated by the following extract from Douglas's book on "Ostrich Farming in South Africa": "One set of three birds—a cock and two hens—during the period from June 30, 1872, to June 30, 1873, laid 188 eggs, which produced 133 chicks; of these 18 died, leaving 115 young birds. Of these, 74 were sold at three months old at £16 each, and allowing the remaining 41 to be worth only £12 each, we have a return of £1,676 from one set of birds. The next year the same set laid 113 eggs, producing 77 chicks; and the first six months of the third year they laid 97 eggs, producing 81 chicks, being over 80 per cent." The eggs vary considerably in size, from $5\frac{1}{2}$ inches to 6 inches long, by $4\frac{1}{2}$ – $5\frac{1}{2}$ inches thick, averaging about the weight of 24 eggs of our common fowl. They are incubated by both parents alternately, the male sitting during the night. In the hottest countries they are left during part of the day, but are then usually covered up with sand. An interesting account of the finding of the nest is rendered by Rev. Mr. Tristram.

"Once, and once only, had I the good fortune to take an ostrich's nest. We had observed with our telescopes two birds standing for some time in one spot, and were induced to ride towards them. By great good fortune we detected their track as we crossed it; for, the stride of the ostrich often measuring, when at full speed, from 22 to 28 feet, and there being simply the round impression of his two toes, it is very difficult to discover its course. We traced these steps back to the spot where we had seen the birds standing, and where the sand was well trodden down. Two Arabs, at once dismounting, began to dig with their hands, and presently brought up four fine fresh eggs, from a depth of about a foot under the warm sand."

Ostrich farming has not only been established in the Cape Colony, but also with great success in Algeria, and in Buenos Ayres, where the African ostrich has been introduced. There can be no doubt but that this industry may be carried on with equal success and profit in our southwestern states, and it is to be hoped that the experiments now in progress in California may give ample returns, and encourage others to invest in this novel branch of "practical ornithology."

That the range of the true ostriches at a former geological period was considerably larger than nowadays is proved by the rather recent discovery of fossil remains of a species from the Siwalik Hills in India. It is named *Struthio asiaticus*, and is distinguished by a stouter neck than the existing species, to which it otherwise is so closely related that Mr. Lydekker thinks it doubtful whether the slight differences can be regarded as of more than individual or varietal value.

Though nearer related perhaps to the African than to the Australian *Struthiones*, the nandus or South American ostriches are sufficiently remote from all of them to warrant their separation as a distinct super-family, the RHŒOIDEÆ. With the latter the nandus share the character of having three toes, as contrasted with the two toes of

their African relatives. The marks which they have in common with them, and which consequently distinguishes both these from the cassowaries and emus, besides those which separate the two *inter se*, have been pointed out briefly under the head of the foregoing super-family, with the exception that in the Rheidae the pubes are free, while the ischia are united in a ventral symphysis, that the maxillo-palatines do not touch the vomer, and that only a left carotid is present. We shall therefore here only mention a feature shared by no other member of the order, viz., the peculiar and highly specialized lower larynx. This was first discovered by the French naturalist, Mr. Alix, in 1874, and afterwards fully described by the late Professor Forbes, who sums up its most striking characters as follows: "In the possession of a tracheal box formed by the fusion of the few last tracheal rings, in the greater amount of specialization of the first two bronchial semi-rings of each side, in the presence of distinct interamular membrane-covered fenestræ, in the development of a well-marked cartilaginous *pes-sulus*, and in the possession of a pair of true intrinsic syringeal muscles running from the trachea to the bronchial semi-rings, *Rhea* stands out by itself as sharply opposed to all the remaining 'Ratite' birds."

Three species, all from South America, are known at present; the old and rather well known "Avestruz" of the Gauchos, and a nearly ally, described about fifteen years ago by Dr. Selater, both referable to the restricted genus *Rhea*, and named respectively *Rhea rhea* (or *Rh. americana*) and *Rh. macrorhyncha*. The latter, the true habitat of which still seems to be doubtful, is considerably smaller, as it stands six inches lower than the female of the common nandu, but has a much longer bill, and is, besides, much darker, the top of the head and streaks at the back of the neck in particular being deep black. Both these are distinguished from *Rh. darwini* in having scutellate tarsi, which in the latter are reticulate. It has therefore been made a separate genus, *Pterocnemia*, a further character of which, in addition to several anatomical differences, is that the leg is plumed below the knee for several inches. The terminal white band on the wing feathers is a striking color mark.

Not only is the nandu the oldest known species, but also the one having the greatest distribution, occurring as it does, from southern Brazil to Magellan's Strait. The general color is a brownish gray, lighter, nearly whitish on the belly; the small and narrow feathers on the crown, nape, and upper neck, are blackish in the male, lighter in the female, which is the smaller of the two, the former measuring about six feet in length, the latter hardly five and a half.

Living on the pampas, and feeding on grasses and seeds of different herbs, and also on the red berries of the *Eupetrum rubrum*, the *Rhea*, like its African cousin, has chiefly to rely upon its legs and acute sight for escaping danger, but seems to have developed considerably more intelligence, though he has often to pay the penalty of a too great curiosity with his life; and Darwin relates how, though fleet in its paces, and shy in its nature, it yet falls an easy prey to the hunters, who confound it by approaching on horseback in a semicircle. He also states that when pursued it generally prefers running against the wind, expanding its wing to the full extent. Mr. Barrows has recently in "The Auk" given some interesting information as to the manner in which the 'Avestruz' is hunted in Lower Uruguay, as follows: "During our stay at Puan, about two hundred Indians united in a two-days' ostrich-hunt, resulting in the capture of about sixty birds of all sizes, from the full grown adult down to two-month 'chicks.' They begin by beating over a large tract of the plain, and then closing in around the game started. Stout greyhounds are used to good purpose, usually pulling

down the swiftest birds within two miles at farthest. The Indians use the 'bolas' with much skill, the one used for ostriches consisting of two half-pound leaden balls, connected by eight feet of twisted rawhide twine. Whirling this about the head and 'letting fly' at the running bird, they often entangle his legs at a distance of thirty to fifty yards, and I was *told* that it was frequently done at one hundred. Single hunters stalk ostriches sometimes in the following way: Getting to windward of the bird, the latter soon scents him and lies down, only sticking up his head above the grass. The hunter may then creep directly up within shot, if the grass be long enough to shelter him, and the bird is shot through neck or head before he rises."

On two occasions, Mr. Darwin witnessed the *Rhea* crossing the Santa Cruz river, where its course was about four hundred yards wide, and the stream rapid. They made but slow progress, their necks were extended slightly forward, but little of the body appeared above water. The statement as regards the swimming capacities of the bird in question has been corroborated by Mr. Cunningham.

The feathers are of little value compared with those of the African ostrich, and are mainly used for rugs, dusters, brooms, etc.; the yield of a *Rhea* will average about three pounds, and the value is from one to two dollars per pound on the spot.

The hen lays from ten to twenty-three eggs in the shallow excavation formed by the male in the ground, and arranged by him with a few leaves and grasses for a nest, but numerous eggs are also dropped here and there over the plains. That these are destined for food for the young chick is a mere myth. Mr. Darwin's experience was to the following effect: At Bahia Blanca, in the months of October and September, an extraordinary number of eggs were found all over the country. The eggs either lie scattered about, or are collected together in a shallow excavation or nest; in the former case they are never hatched, and are termed by the Spaniards *Huachos*. The Gauchos unanimously affirmed, and later experience with birds in captivity corroborates it, that the male bird alone hatches the eggs, and for some time afterwards accompanies the young. Mr. Darwin also states that the cock bird sits so closely that he has almost ridden over one on the nest.

Before closing the present account we shall reproduce the yarn told Mr. Barrows by one of the natives, who thought he had found an explanation of the many eggs spread over the plains. When an ostrich has built a nest and laid the full number of eggs, he argued, she is naturally anxious to be able to find the nest again after having wandered away to any distance. This she manages by simply laying eggs at intervals of half a mile or so over the adjacent country, placing each egg with its smaller end pointing directly towards the nest! *Ben trovato!!*

The "Avestruz Petise," as *Rh. darwini* is called by the Gauchos, is smaller, and is said not to expand its wings when running at full speed, as does the common species. It inhabits Patagonia, from Magellan's Strait to the Rio Negro.

Both as regards geographical distribution and anatomical peculiarities, the cassowaries and emus, the superfamily CASUAROIDÆ, hold a somewhat isolated position in the present geological period. Most significant, perhaps, is the extreme reduction of the fore-extremities, which could hardly become smaller without disappearing altogether externally; the hand has, moreover, only one claw-bearing finger. They are furthermore distinguished from the two foregoing groups in that neither pubes nor ischia unite into a ventral symphysis. The ambiens muscle is absent, though present in the other Dromæognathæ, and the feathers are provided with aftershafts, contrary to what is the case in *Struthio* and *Rhea*. Both carotids are developed.

The members of this superfamily are at present confined to the Australian and Indo-Malayan region, but fossil remains have been found in India and also in Europe, if the so-called *Macrornis* and *Megalornis*, from the London clay, really belong here.

The first family, the DROMAIDÆ, which embraces only the emus, represent in the Australian deserts and plains the ostriches of Africa and the Rheas of South America, but are smaller than the former, though larger than the latter, standing, as they do, about five feet high. As their position within the same superfamily as the cassowaries indicates, their affinities are with the latter, from which they are easily distinguished by the absence of the helmet on the top of the head; neither do they have the spiny rudiments of wing feathers, nor the nail of the inner toe lengthened unusually; the nostrils are placed near the middle of the beak, and not in the anterior half of it, as in the cassowaries. The neck and most of the head are feathered, and the feathers less hair-like. Of anatomical characters may be mentioned that the clavicles, though reduced and separate, are less rudimentary than in the birds composing the following family, and that the femoro-caudal muscle is absent, while present in the cassowaries.

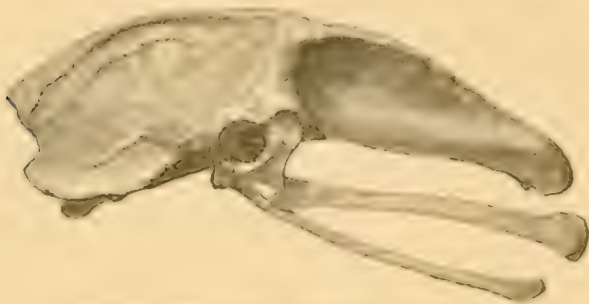


FIG. 18. — Pelvis of emu (*Dromaius nova-hollandia*).

Not more than two species are conceded by the best authorities, — the *Dromaius nova-hollandia*, inhabiting eastern Australia, and *D. irroratus*, from the southern and western parts of that continent, — both of a brownish color; the latter however, with the individual feathers of the body distinctly

marked with narrow transverse bars of light grayish and brownish black.

The emu was first described and figured under the name of the New Holland cassowary in Governor Phillip's "Voyage to Botany Bay." According to Mr. Gould, "the old Bush-man," whose account of the Australian birds must be the chief source and foundation of all information concerning the ornithology of that remarkable region, during the earlier days of the colony, the emu was universally dispersed over the whole of the Australian continent. The encroachment of the white man, however, has now caused its almost extirpation in many parts; though good emu coursing, which is said to be excellent, and equalling, if not surpassing, the same sport with the hare in England, may still be had in districts where the settlers have not yet commenced their merciless war against the native animals. It is stated, however, that dogs will seldom attack it, both on account of some peculiar odor, and because of the dangerous injuries it inflicts by striking out with its feet; to avoid which, the well-trained dogs run up abreast and make a sudden spring at their neck, whereby they are quickly despatched. Mr. Cunningham asserts that but little of the emu is fit for culinary use except the hind-quarters, "which are of such dimensions that the shouldering of two hind-legs homewards for a mile distance once proved me as tiresome a task as I ever recollect to have encountered in the colony."

According to Gould, the only vocal sound the emu has been heard to utter is a low booming or jumping noise. The eggs are six or seven in number, of a beautiful dark-

green, resembling shagreen in appearance, and measuring five inches and three-quarters in length. They are merely placed in a cavity scooped in the earth, generally in a sandy soil. Emus breed readily in captivity, are easily tamed, and will stand a temperate climate very well. The emu is eminently a bird of the plains, and in that respect wholly different from its near ally, the cassowary, which is the only type of the order inhabiting the forests. It feeds nearly exclusively upon vegetable matter, chiefly "fruits, roots, and herbage."

The recent discovery of a fossil bird of this family in the tertiary deposits of India is extremely interesting, since it conclusively proves that the emu were formerly not confined to Australia. The remains — four phalangeal bones — have been referred to the genus *Dromaius* with a query, but Mr. Lydekker thinks there is every probability that his *D. sivalensis* is the ancestral form of the recent bird.

It has been supposed that the bird *Hippalectryx*, or "horse fowl," mentioned by the ancient Greek poet, Æschylos, as pictured on a Persian tapet, is the same which is now called cassowary or emeu. However, it was not before the close of the sixteenth century that the western nations of Europe learned of the existence of this remarkable bird. A live specimen was brought to Amsterdam in 1597 by a Dutch skipper, and was finally presented to the Roman Emperor as a most valuable and unique gift.

Linnaeus knew only one species, and it was not until recently that many additional forms were made known, so that not less than about ten species are now admitted by the latest authorities on the subject. Restricted as the geographical distribution of the whole family, the CASUARIDÆ, is, that of the separate species is still more so, for the cassowaries are confined to the Papuan or Austro-Malayan subregion, eight species occurring in the Papuan Islands, while one is a native of the northeastern peninsula of the Australian mainland, and another belongs to the island of Ceram. Of the eight Papuan species, five inhabit New Guinea itself, each species, however, its own district, while of the remaining three, each one occupies an isolated small island, or island group, of itself, viz., Jobi, Wammer, and Kobroor, of the Aru group, and New Britain.

Contrary to the true ostriches, the nandus, and the emus, the cassowaries are strictly confined to the dense forests or scrubs, and not to the open plains or deserts. Their organization, therefore, shows some peculiar modifications not present in the other birds mentioned. The most obvious feature in this respect is the helmet or horny casque on the top of the head (the particular use of which will be shown further on) covering a core of very light spongy bony tissue, with an external layer, no thicker than fine paper, but nevertheless very firm. The naked parts of the head are more or less wrinkled and supplied with wattles, and are gayly colored with blue and red, or blue and yellow. In the rudimentary wing are four to six strong feather-shafts without barbs, apparently remnants of the remiges of their flying ancestors, but now from want of use reduced to mere spine-like structures. In a fresh specimen examined by me, the wing measured four inches, the chord of the nail was two inches, and the longest shaft fourteen inches. Of the three-toed feet the inner toe is short, but armed with a long and sharp claw which serves as a formidable weapon. With these external characters are associated several important anatomical peculiarities, so that the validity of the family as such cannot well be questioned.

The family is only known to comprise a single genus, of which the species fall in two groups, according to the shape of the helmet, whether compressed or not. The species themselves are only slightly differentiated, and the main characters are derived from the number and form of the wattles, the color of the naked parts, and the out-

line of the helmet. It is interesting to remark that the two species most distant in space, and which both occur outside of the Papuan fauna strictly, viz., the *Casuarius casuarius* (or *galeatus*) from Ceram, and *C. australis* from northern Australia, are very nearly related and rather difficult to distinguish.

Of the latter species we have an excellent life-history by Mr. E. P. Ramsay, from whom the following account, which will also serve for the other species, is borrowed: One of the chief objects of my visit to Rockingham Bay was to become acquainted with the habits of this noble bird. While in Brisbane on my way up, I found that several very young cassowaries had been obtained, and, for the first time, a nest and eggs had been found. This was great news; and I need not relate how I made all haste for the Herbert-River Police Camp, where I was most hospitably entertained and welcomed by Inspector Johnstone, who was the first to rediscover and bring under the notice of others the existence of this remarkable species.

The Australian cassowary is a denizen of the dense dark scrubs scattered over the district of Rockingham Bay, northeastern Queensland, and extending as far north as the Endeavour River. It was tolerably plentiful only a few years ago even in the neighborhood of Cardwell; but since the advent of sugar-planters, &c., on the Herbert River and adjacent creeks, these fine birds have been most ruthlessly shot down and destroyed for the sake of their skins, several of which I saw used for hearth-rugs and door-mats. Formerly, they were easily enough procured; but latterly, so wary have they become, and their numbers so decreased, that it is only with the greatest amount of patience even a stray shot can be obtained. I know of no bird so wary and timid. During the day they remain in the most dense parts of the scrubs, wandering about the sides of the watercourses and creeks, diving in through the bushes and vines at the slightest noise. Towards evening and early in the morning they usually visit their favorite feeding-trees, such as the native figs, Leichardt-tree, and various species of *Acmena*, *Jambosa*, *Davidsonia*, etc.; they appear to be particularly fond of the astringent fruit of the Leichardt-trees, and of a species of *Maranta*, which produced bunches of large seed-pods filled with juicy pulp, resembling in appearance the inside of a ripe passion-fruit (*Passiflora edulis*). Fruit and berries of all kinds are eagerly sought after; the tame semi-adult bird which I had become so fond of the fruit of the cape-mulberry that he would allow no one to come near the tree he had taken possession of. This bird had frequently devoured at a time as much as three quarts of 'loquats' (fruit of *Eriobotria japonica*), and several fair-sized oranges whole, besides its usual amount of bread per diem (about three pounds). In nature I found that in the afternoons they frequently came out and walked along the scrubs, or along the side of the river or creek, and swallowed large quantities of pebbles and small rough-edged stones. In confinement, plantains and sweet potatoes (in large pieces which they can swallow whole) are a favorite food, while nothing seems to come amiss to them—grasshoppers, spiders, earth-worms, cockroaches, caterpillars of all kinds, dough, and even raw meat. In confinement they become very tame. If disappointed or teased, they not unfrequently "show fight" by bristling up their feathers, and kicking out sideways or in front with force sufficient to knock a strong man down—a feat I have witnessed on more than one occasion. These birds are very powerful, and dangerous to approach when wounded. On more than one occasion a wounded bird has caused a naturalist to take to a tree; the sharp nail of the inner toe is a most dangerous weapon, quite equal to the claw of a large kangaroo, and capable of doing quite as much execution.

I found the cassowaries to be excellent swimmers, and frequently tracked them across a good-sized creek or river. Their note, most usually emitted by the male, is a series of harsh, guttural, prolonged croakings, quickly repeated, and continued for about three minutes; it is very loud, and may be detected across the water, at a distance of at least three miles, on a still night. I have listened to its resounding through the scrubs at a distance of one and one half miles on land, and then thought it close, and one of the most unearthly noises I ever heard.

They breed during the months of August and September. The nest consists of a depression among the fallen leaves and debris, always in the most dense part, and well concealed by entangled masses of vegetation. The eggs were five in number in the only two instances recorded, and, in both cases, one of the eggs in each set differed from the other, being of a light-green color, and having a much smoother shell.

The young are of a dull rusty brown. After the second season, at the age of 18 to 24 months, the black feathers predominate, and the helmet, which has hitherto been undeveloped, more like the shield of a coat, begins to show a keel or ridge in the centre, which rapidly increases in height. The skin round the head begins to become wrinkled and colored, varying from bluish-green to orange on the lower part, and bright blue on the sides of the neck, the wattles becoming carmine. The helmet still remains comparatively small and undeveloped long after the wattles and naked parts of the neck become colored. I believe that the helmet does not attain its full size until the fourth or fifth year at least. In traversing the scrubs the head is carried low to the ground, and the vines and branches of trees striking the helmet slide over it on to the back. Otherwise in the dense vine-scrubs bordering the Herbert River and elsewhere, progress would be greatly impeded; but as it is, the cassowaries traverse the scrubs with wonderful speed, jumping over fallen trees and logs when in the way.

The Superfamily of extinct birds DINORNITHOIDEÆ, which, by some authors is regarded as having ordinal value, under the name of Immanes, inhabited Australia and especially New Zealand during a not so very distant period, geologically speaking. They were first introduced to the scientific world by Professor Richard Owen in 1839, who designated them by the name *Dinornis*, giant bird (from the Greek *deinos*, tremendous, formidable), and are now generally known as moas, the name used by the Maori, the natives of New Zealand. Moa is the equivalent of the Polynesian word "toa," which means the domestic fowl, — a significant fact, as it shows that the Maoris found the giant birds alive when they immigrated into the islands.

The moas form one of the most interesting groups in ornithology, not only because they help to fill a gap between the other Struthious birds, particularly the Casuariidae, and the wonderful kiwis, or Apteryges, but also because they are an extreme example of the feathered, and therefore originally flying, bird-type, becoming modified into an animal bound and fitted as exclusively to the ground as the horse or the elephant. And, elephant-birds, indeed, might we call them, were it not that this name would even better fit another group of extinct Struthious birds, the *Æpiornithes* from Madagascar. The moas show the extreme reduction of the wing among birds, their fore-limbs being nearly as much atrophied as are the hind-limbs of the whale. By long disuse, the wings, as they became useless for the acquisition of food, and unnecessary for escaping danger, since no enemies existed, would become enfeebled and ultimately reduced to mere rudiments, while "the legs, then monopolizing the functions of locomotion, would attain, through the concomitant force and frequency of exercise, proportional increase of power and size." (Owen.)

The bones have been met with under the most different conditions, some scattered over the surface, others buried loosely in the sand, others in the old native cooking-places or graves, others again in the alluvium of rivers, marshes, or in caves, sometimes so numerous that they have been dug out by the ton. The most remarkable find in that line is the exhumation by Mr. Booth, at Hamilton, of three and a half tons of moa-bones from a single half-dried lagoon surrounding a spring, the number of bird-



FIG. 12.—*Dinornis ingens*, Moa, from Hoechstetter's restoration. The small birds are kiwis.

skeletons accumulated there being estimated at more than four hundred. Moa skeletons are therefore no longer rarities in the museums; fine collections are in London, in Vienna, and other European museums, not to speak of the magnificent series which are preserved in the colony itself; also museums in this country have received valuable material, the American Museum of Natural History in New York, however, being in the lead with its elegant collection of mounted moa skeletons.

Thanks to this ample material we know the moas pretty well, and about fifteen species are now recognized. Owing to the presence of a hind toe, as in the kiwis, a number of species were first separated by Owen as a distinct genus, *Palapteryx*. This division was carried further by Dr. Haast, who made *Dinornis* and *Palapteryx* the basis of two families, including two additional genera. Of these *Meionornis* was made to include the species *D. casuarinus* and *didiformis*, the former the type of

Reichenbach's genus *Syornis*, the latter the type of the same author's *Anomalopteryx*, both established in 1852. It is quite probable that the distinction derived from the presence or absence of a back toe will not hold, as it may have been present in all the species, though not found with the skeletons, for no safe conclusion can be made from the absence of an articular surface on the metatarsal bone, as proven by the presence of a hind toe in *D. parvus*, notwithstanding the fact that it is not indicated in the character of the metatarsus.

The *Dinornithes* are related to the kiwis, together with which they inhabited New Zealand, as kiwi bones have been found associated with those of the more or less fossilized moas, but in some characters they agree better with the emus and cassowaries of the Australian mainland and the Papuan islands, and it is therefore a very important discovery that remains of moas have also been found in Australia, in a post-pliocene deposit in Queensland.

The most striking peculiarity of this group is the enormously massive structure of the hind extremities, which reaches its maximum in *D. elephantopus*, a name truly suggestive of the extreme development of the feet. Concomitant with these large hind limbs is the very rudimentary condition of the fore extremities, which were nearly obsolete. The front edge of the small, flat, and keelless breast-bone has two

small impressions for the rudimentary coracoids, which, in one of the larger species, are only two inches long, while shoulder-blade and wing-bones seem to be wholly wanting. The head is particularly small in the larger species; *D. parvus*, the smallest species, has relatively the largest skull.

The size varied very noticeably in the different species. The smallest (*Dinornis parvus*) was not larger than a dodo; others, for instance, *D. ingens*, reached the African ostrich in size; *D. maximus* was nine or ten feet high; and other individuals have been recorded having a height, when standing erect, of thirteen to fourteen feet. Two series of different size have been recognized in various species, and from the analogy of *Apteryx*, the larger individuals are regarded as females.

The eggs, a considerable number of which have been found, were of a dark green color, while others seem to have been of a paler yellowish tint. Their volume was considerably greater than that of ostrich eggs, a recently found, nearly perfect, egg measuring about ten inches in length by seven in breadth, or "so large that a hat would make a good egg-cup for it," but without equalling in capacity those of the *Epiornis*. In one of them the bones of a young fetus were found, from which could be demonstrated that even at that early age the bones belonging to the hind extremities were much more voluminous than in the now existing types of Struthionies.

But not only have the bones and eggs of moas been found in great numbers, but also single feathers and parts of skeletons, with muscles, shreds of skin, and feathers adhering, in a remarkable state of preservation.

Some of the feathers were as bright as if they had just been pulled out. They were double,—in other words, were furnished with an 'aftershaft,' resembling somewhat those of the Australian wingless birds. In one species they were of a reddish brown near the base, passing into black, while the rounded tip was pure white. Others have been found of a pale yellowish brown color, others again of a blackish brown. Feathers from a cave near Queenstown were reddish brown with a terminal dark-brown shaft streak. These large feathers (some measuring as much as six inches) probably covered the body. A most extraordinary specimen, consisting of seven vertebræ from the lower end of the neck, with their muscles, skin, and feathers, is so interesting, that we allow ourselves to make an abstract of the best description accessible to us.

Upon the portion of this specimen corresponding to the first dorsal vertebræ, the skin is seen to be covered with large conical papillæ which nearly touch each other, and give the whole the appearance of a rasp. A certain number of these papillæ bear double-stemmed feathers of a reddish-chestnut color, furnished with barbs, and nearly two inches long. The papillæ diminish in size, and the feathers in length, on arriving at the level of the vertebræ of the neck. Soon the feathers appear to be



FIG. 20.—*Dinornis ingens*.

reduced to mere hairs, and they disappear entirely upon about half the specimen. There the papillæ are much smaller and are distinctly separated from each other.

With the data furnished by the skeletons and the other remains now in the different museums, we are enabled to give a pretty reliable picture of these birds, which probably became extinct before civilized men discovered their native land, supplying the wanting details from their nearest allies among the living dromæognathous birds. They are described as representing the general form of the cassowary, but upon a much larger scale, particularly in regard to the hind extremities, while the anterior ones were still more abortive. Like the cassowary, they had the greater part of the neck naked, but were destitute of the bony crest, in this respect resembling the emu. Very probably the legs were naked, and the body was covered with silky plumes, in which darker or lighter and more or less reddish tints of brown predominated, variegated with black and white, at least in some species.

To Mr. John White, who devoted more than thirty-five years in collecting all possible information from the Maori, the natives of New Zealand, and to various other gentlemen (among them Sir George Grey), the scientific world is indebted for much valuable information concerning the habits of these birds, derived from the folk-lore, songs, and proverbs of the natives. Thus the Maori have a proverb, "as inert as a moa," which indicates that these birds were sluggish and stupid animals; and the following life history has been drawn from similar sources. They were essentially sedentary, and went about in pairs, accompanied by their young. No doubt they sometimes disputed the field on which they were seeking the same food, for the Maori still, in speaking of a struggle between two pairs of combatants, say: "Two against two, like the moas." Their nests were formed of various dried grasses and fragments of ferns, simply brought together in a heap. They ate various species of plants growing upon the borders of the woods and marshes, the young shoots of certain shrubs, etc.; but their principal food appears to have been the root of a species of fern (*Pteris esculenta*), which they dug up either with the beak or with the feet. To assist in the grinding of the food swallowed, the moas, like many other birds, ate small pebbles, which, when rounded and polished by friction in the stomach, and thus rendered unfit for further service, they disgorged, just as do the ostrich and the emu. These "moa-stones" are found in great numbers, often in small heaps near skeletons, in a position indicating the place of the gizzard, thus proving that the bird died on the spot where the skeleton is now found.

Being the only large indigenous warm-blooded animal, the moa was, of course, eagerly hunted by the Maori, although Mr. White writes that they were afraid of it, as a kick from the foot of one would break the bones of the most powerful brave; hence the people made strong spears of maire, or manuka wood, six or eight feet long, the sharp end of which was cut so that it might break and leave six or eight inches of the spear in the bird. Before the chase, the hunters engaged in prayers, invoking the assistance of those spirits to whom they attributed the power of sending good or ill fortune, supplicating, for instance, the "mist of the hills where the chase was to take place so to act that the fat of the birds may flow like the drops of dew which falls from the leaves of the trees at the dawn of a summer day; or the god of silence to keep the moas free from apprehension and fright." Some of the hunters would then conceal themselves behind the scrub on the side of the track (many of which are still visible, being about sixteen inches wide, and of a seemingly fresh appearance), while others drove them from the lakes towards the ambush. "Here the

spears were thrown at them, and the scrub on the sides of the track would catch the spears and break the jagged end off, leaving it in the bird. As it had to pass many men, the broken spear-points caused it to yield in power when it had gained the open fern-country, where it was attacked in its feeble condition by the most daring of the tribe." The killed-bird was cut up with a knife of obsidian, made for that exclusive use, and which only served a single time. "What wild, weird scenes," exclaims Russell, "those deep valleys of the southern Alps must have witnessed, when, after the successful hunt, the natives gathered about their camp-fires, that lit up their dark tattooed faces, and shone on the strange vegetation around, to feast on the flesh of moa, or partake of its huge eggs, roasted on the hot stones of the oven!"

It will be perceived from many of the facts related above that the extermination of the giant-birds of New Zealand cannot have taken place at a very distant period. Dr. Haast, on the contrary, has taken the position that the moas were extinct before the immigration of the Maori race, which now inhabits the islands, occurred, and that these huge birds had been exterminated by an aboriginal people which he calls the "moa-hunters." This theory has been successfully opposed by Mantell, Dr. Hector, Hochstetter, and especially by Mr. A. de Quatrefages, from whose interesting memoir (1883) much of the above has been borrowed. We may perhaps not be prepared to accept as fully trustworthy the testimony of Haumataugi, the old Maori, who in 1844 related that during his childhood he had seen living moas, a statement which would bring the year of extinction down to about 1770 or 1780; still we cannot doubt that the extinction took place at a comparatively recent date, as it is otherwise impossible to account for the discovery of remains of soft tissue in such a condition that the muscles could still be dissected; especially if we remember that the climate of New Zealand is mild and moist, conditions favorable to a speedy dissolution of the carcasses. We may finally record the view of a man who, more than anybody else, has a right to be heard in this question, viz., Professor Richard Owen. As late as 1882 he expresses the opinion that "in the remote, well-wooded, and sparsely populated districts of the southern division of New Zealand, a recovery of a still-existing specimen of moa might be less unlikely than that of the *Notornis*, also originally recognized by fossil remains."

ORDER II. — ÆPIORNITHES.

Eleven years after the discovery of *Dinornis* had been announced by Owen in England, some few remains of a not less gigantic bird from Madagascar reached the museum at Paris, and two days after, on the 27th of January, 1851, Isidore Geoffroy-Saint-Hilaire read before the Parisian Academy of Sciences a paper, in which he described two enormous eggs and part of the metatarsus of a bird which he called *Æpiornis maximus*, meaning "the bird big as a mountain."

This brought again to mind the old story of the famous Venetian traveler, Marco Polo, who located the roc or roc, the giant bird of the Arabian tales, upon Madagascar, and related that the Great Khan of the Tartars, having heard of the bird, sent messengers to Madagascar, who brought back a feather nine spans long, and two palms in circumference, at which His Majesty expressed his unfeigned delight. This, like so many others of his strange tales, had been regarded as a fable, but now there were enough of believers who were satisfied that the egg of the roc had been found; for the eggs exhibited measured nearly 34 inches in circumference, and would hold more than two gallons: in other words, had a capacity of nearly 150 hen's eggs.

or 17 cassowary's eggs, or 6 ostrich eggs! The length measured 12.6 inches, the breadth 8.6 inches, and the shell had a thickness of 0.11 of an inch. No wonder that the natives employed them for different domestic purposes. In fact, the first knowledge of the eggs was received when some Madagascar natives came to Mauritius to buy rum, bringing *Æpiornis* eggs with them to hold the liquor. This led to inquiries, and two eggs and some fragments of bones were obtained by Mr. Malavois, and sent to Paris. Since that time other remains, which have furnished the material for Alphonse Milne Edwards's investigations, published in 1869 and 1873, were discovered by Grandidier and others.

It has been shown that the earlier calculations of the size of *Æpiornis* were much too high, and that *Æ. maximus* in reality was not taller than a large African ostrich, notwithstanding the enormous size of the egg, and that the smallest of the three species known, *Æ. modestus*, was not much larger than the great bustard. The more astounding is the stoutness and massiveness of the hind extremities, which were still more 'elephantine' than those of the elephant-footed moa. The characters of the bones at once refer the elephant-birds of Madagascar to the neighborhood of the ostriches and moas, particularly the former; and, as they seem to have had only three toes, Professor Bianconi's idea that they were rapacious, or rather condor-like, birds — the rue was said to be a bird of that order — is not well founded. An additional proof is that the microscopic examination of the egg, according to Nathusius, shows an approach to that of *Struthio*, and bears no resemblance to that of the larger raptorial birds.

The chief characters of the bones known are the remarkable widening and flattening of the metatarsal bone; the enormous size of the leg-bone, which is over 25 inches long, with a circumference at its upper extremity of 18 inches, while the bone at its most contracted portion is only 6 inches round, thus showing a singular enlargement of the articular ends; it differs from the same bone in the *Dinornithoideæ* in having no osseous bridge over the groove of the extensor muscle of the toes, in this respect agreeing with the existing *Struthionæ*. The thigh-bone was of singular proportions, being of extraordinary thickness, while in length it does not measure one half more than its lower extremity; it was pneumatic, contrary to what exists in *Apteryx* and *Dinornis*.

The natives of Madagascar assert that a few of the giant birds are still alive in some of the most secluded and unexplored parts of the island, and occasionally an exciting report of some traveler having been in the neighborhood of them reaches us through the newspapers, but the probability is that they are totally exterminated, and without doubt by the hand of man, as the famous French traveler Alphonse Grandidier emphatically assures us; but there are reasons to believe that the report of some having been still alive not more than two hundred years ago is not entirely unfounded. The whole history of the *Æpiornithes*, the enormous, massive *Struthionæ* birds, confined to a large island in the southern seas, and extinguished by the action of man, is a remarkable counterpart of that of the moas on New Zealand.

ORDER III. — APTERYGES.

The English naturalists who, about seventy years ago, received the first kiwi skin from New Zealand through Captain Barclay, of the ship 'Providence,' were greatly perplexed as to the relationship of that singular bird, not larger than a hen, and which had no wings, was covered with hair-like feathers, possessed a long beak with

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41 ARCH STREET



Mojos Indians of Bolivia. (From a photograph.)



Megalobatrachus maximus, giant salamander.

the nostrils placed at the tip, and had four toes. Latham called it the "apterous penguin," since it had four toes and no wings, remarking, however, that "the form of the foot is not greatly unlike that of the dodo, and in the above specimen the toes were not connected by an intervening membrane; yet from certain inequalities on the sides it is possible that there may have been one, and that it had been eaten away by insects." Shaw, making it the type of the genus *Apteryx*, 'the wingless bird,' did not remove it from the neighborhood of the penguins, pointing to the fact that the bill also was "somewhat in the form of that of the Patagonian penguin." Temminck united *Apteryx* and *Didus*, the dodo, into a separate "order," the "Inertes," but "could not find a more convenient place for these two genera than by associating them in some way or another with the penguins." It was not before Yarrell in 1833 described the curious bird, that its true nature as a near ally of the Struthious birds was generally understood and admitted. Numerous specimens of kiwis (Fig. 19), have since been obtained, and not less than four living species are now represented in the different museums, while a fifth one (*A. maxima*, the largest one, being of the size of a turkey) is only known from remains of a skin forming part of a Maori-chief's dress. We have now also full and excellent descriptions of the internal anatomy of these birds from the master-hands of Richard Owen and Huxley, besides not less valuable information concerning their habits and way of living, as observed by such men as Dr. Buller and the other New Zealand naturalists of recent fame.

Like the other related birds, the kiwis are dromæognathous, but the vomer unites with the palatines and pterygoids, contrary to what is the case in the ostrich; there are no clavicles at all, and the arm, or wing, is rudimentary, as in the *Casuarioideæ*, the hand having only one ungual phalanx, which is provided with a long external claw; like the latter, they have both ischium and pubis free except in front. The ambiens muscle is strong, as in *Struthio* and *Rhea*, while it is absent in *Casuaris* and *Dromaius*. It was long believed that the respiratory system was quite peculiar, and more especially that the kiwis possessed a kind of diaphragm corresponding to the membrane dividing the cavity of the body in mammals, but quite recent investigations of Professor Huxley show that the respiratory organs on the whole are like those of most other birds, and that the diaphragm is a myth, there being not a trace of such a membrane. Only the left carotid is present, there being two in other Struthious birds except *Rhea*. The most noteworthy external features are the long snipe-like bill, with nostrils opening near the end; the rudimentary wing, which supports a row of numerous rudimentary quills, evidently degraded rectrices; absence of separate tail-feathers; presence of a short, elevated hind toe; finally, a covering of more or less bristly feathers with downy bases, but without aftershafts, in this respect differing highly from the cassowaries, emus, and moas; the fore part of the head and sides of the face are beset with straggling hairs, or feelers, varying in length from one to six inches.

Dr. Buller says that a full and complete history of the wingless birds which, even to the present day, form the most distinctive feature in the avi-fauna of New Zealand, would necessarily fill a volume. We shall therefore here only remark that of the four existing well-known species, one, *A. mantelli*, inhabits the North Island alone; two others, *A. australis* and *haasti* are confined to the South Island, while *A. orceus* is found on both islands. The general color is a dull mottled brownish or grayish, the latter and smaller species being rather gray, and therefore usually called the gray kiwi. *A. haasti* is the "roa-roa," of the natives, and is the larger one. The two other species can hardly be told apart by sight alone, but are said

to be readily distinguished by the touch; for in the South Island kiwi (*A. australis*) the feathers of the upper parts feel soft and yielding when stroked against the grain, whereas in Mantell's kiwi, from the North Island, the feathers have stiffened points, and are harsh and prickly to the touch, owing to a peculiarity in the structure of the shaft.

The kiwis are nocturnal birds, the different species having nearly identical habits, and the following life history of the commonest species, *A. mantelli*, which we borrow from Buller's excellent account, will therefore also cover the other.

Of a bird kept in captivity, he writes: It appears to be blinded by the strong glare of sunlight, and although it recovers itself in the shade, it can then only detect objects that are near. Night is the time of its activity, and the whole nature of the bird then undergoes a change. Coming forth from its diurnal retreat full of animation, it moves about the aviary unceasingly, tapping the walls with its long, slender bill, and probing the ground in search of earth-worms. The feeding of this bird at night with the large glow-worm is a very interesting sight. This annelid, which often attains a length of twelve, and sometimes twenty inches, with a proportionate thickness, emits at night a bright phosphoric light. The mucous matter which adheres to its body appears to be charged with the phosphorus, and on its being disturbed or irritated, the whole surface of the worm is illumined with a bright green light, sufficiently strong to render adjacent objects distinctly visible. Seizing one of these large worms in its long mandibles, the kiwi proceeds to kill it by striking it rapidly on the ground, or against some hard object. During this operation the bird may be clearly seen under the phosphoric light; and the slime which attaches itself to the bill and head renders these parts highly phosphorescent, so that, even after the luminous body itself has been swallowed, the actions of the bird are still visible. There is no longer the slow and half stupid movements of the head and neck; but the bill is darted forward with a restless activity, and travels over the surface of the ground with a continued sniffing sound, as if the bird were guided more by scent than by sight in its search for food. Of some young birds he remarks that they are particularly savage, using their feet as weapons of offence, and manifesting their anger by an audible snapping of the bill; at other times they emitted a peculiar chuckle, but only once he heard them produce the loud whistling cry which is so familiar to the ear in the wild mountain-haunts of the kiwi. They often huddled together when at rest, laying one upon another, like little pigs; and when sound asleep no amount of noise would rouse them.

The kiwi, Dr. Buller continues, is in some measure compensated for the absence of wings by its swiftness of foot. When running, it makes wide strides, and carries the body in an oblique position, with the neck stretched to its full extent and inclined forwards. In the twilight it moves about cautiously, and as noiselessly as a rat, to which indeed, at this time it bears some outward resemblance. In a quiescent posture, the body generally assumes a perfectly rotund appearance; and it sometimes, but only rarely, supports itself by resting the point of the bill on the ground. It often yawns when disturbed in the daytime, gaping its mandibles in a very grotesque manner. The story of its striking the ground with its feet to bring the earthworms to the surface, which appears to have gained currency among naturalists, is as fanciful as the statement of a well-known author that it is capable of "inflicting a dangerous blow, sometimes even killing a dog."

While hunting for its food, the bird makes a continual sniffing sound through the nostrils. Whether it is guided as much by touch as by smell, I cannot safely say; but

it appears to me that both senses are called into action. It is probable that, in addition to a highly developed olfactory power, there is a delicate nervous sensitiveness in the terminal enlargement of the upper mandible. It is interesting to watch the bird, in a state of freedom, foraging for worms, which constitute its principal food; it moves about with a slow action of the body, and the long, flexible bill is driven into the soft ground, generally home to the very root, and is either immediately withdrawn with a worm held at the extreme tip of the mandibles, or it is gently moved to and fro, by an action of the head and neck, the body of the bird being perfectly steady. On getting the worm fairly out of the ground, it throws up its head with a jerk, and swallows it whole.

The enormous size of the kiwi's egg has often been the subject of speculation and comment, for, until the fact was established beyond all question, it seemed almost impossible that the very large eggs occasionally brought in by the natives were the produce of this bird. The evidence has been furnished by eggs laid in the Zoological Gardens, and by another taken *in utero*. One of the former is stated to have weighed $14\frac{1}{2}$ ounces, or about one fourth of the bird's own weight. The probability is that the male alone sits on the egg. The kiwis are monogamic.

ORDER IV.—CRYPTURI.

Even the older authors were aware of some of the Struthious features of these small South American ground-birds, which usually are referred to the Gallinaceous order. Illiger remarked as early as 1811 that "the bill is wonderfully conformable with that of *Rhea*," and later on (1835) Sundevall stated that they "recall small ostriches." Their small size, and a certain superficial resemblance to the gallinaceous birds prevented the recognition of their true nature until Parker's celebrated anatomical monograph appeared in 1865. The presence of a crest on their breast-bone, however, seemed to Huxley to be so strong a character, that he would not admit them to the division including the ostriches, and so he made of them a separate order, the distinctive feature of which was the predominance of Struthious characters. We have stated above, why the presence or absence of a keel to the sternum seems to us to be a matter of only slight consequence, particularly when seeing that most of the other characters of importance are chiefly struthionine. That certain birds of other orders for instance, *Dendrotyx*, *Heimipodius*, *Syrnhaptes*, the rails, and the plovers, present characters to a certain degree also found in the Crypturi, is quite natural, as these forms are comparatively generalized and therefore possess the reptilian features of the common ancestors less obscured than their more specialized relatives of the Euornithic series or super-order. It is therefore not quite correct to say that the Crypturi are intermediate between the Struthious and the Gallinaceous birds, when the fact is that the latter are intermediate between their own and the Dromæognathous birds' common ancestors, on the one hand, and those of the rest of the Euornithes on the other.

Not only is the bill struthionine, but still more so the palatal arrangement, for the broad coalescing vomer in front joins the end of the broad maxillo-palatines, receiving behind the hinder end of the palatines (which do not articulate with the basisphenoid), and the anterior ends of the pterygoids. Another struthious feature is that the head of the quadrate bone is single. Notwithstanding the fact that the wings of the tinamous, as the birds of this order are called, are functional, the shoulder-girdle and the sternum present enough characters to show that they have "not escaped from the

struthious group, yet," as Parker puts it. According to this authority, the wings also seem to be struthious rather than gallinaceous, for in the humerus the crest for the insertion of the *pectoralis major* is not turned over as in the fowl; this answers to the extreme (struthious) thinness of that muscle in the tinamou, this bird having but little power to *depress* his wings. He can *deviate* them, however. It is highly inter-



FIG. 21.—*Crypturus megapodius*.

esting, he says, to see the tinamou *lift* his wings, just in the same manner as the ostrich elevates hers. The tinamou's "organs of flight" are still much more rudimentary than those of the fowl, seeing that they are constructed far more for elevation than for depression, the latter movement being the one so necessary to flight.

Again the pelvic arch presents the very mark common to the birds we have hitherto treated of, namely, that the ischium is not united with the backward extension of the ilium by bone, as is the case in all other birds. To the struthious character of the breast-muscles corresponds peculiarities of the muscles of the legs, of which the accessory femoro-caudal has a slip arising above the sciatic foramen, found elsewhere, according to Garrod, only in the Struthionæ. Finally, Dr. Nathusius has found that the minute structure of the tinamou egg-shells is quite different from those of the true Gallinæ, in that respect showing most resemblance to *Apteryx*.

Among external characters may be mentioned that the bill is depressed, and the mouth split open to under the eyes; the head is comparatively small, the neck rather long and narrow. The wings are short and rounded, the tail feathers con-

cealed under the coverts, or altogether absent. The feet are provided with a rather short hind toe, elevated from the ground. Powder-downs are present among the feathers, and in some the feathers have aftershafts.

Several genera with a number of species, about fifty, distributed in two sub-families, are recognized from Central and South America, where they are usually known as Perdiz, partridge, being in fact, as game birds, a kind of substitutes for true Gallinæ. Their size ranges between that of a ruffed grouse and a ring plover. They are eminently ground-birds, which never perch on trees or shrubs.

The largest and best known species is the Perdiz grande or P Ynambu (*Rhynchotus rufescens*) from Brazil southward. It is of a rusty yellow, banded crosswise on the upper surface with blackish; bill rather long, with the nostrils in the basal part, hind toe well developed, and tail feathers short and soft. Mr. Hudson, having the opportunity of studying the habits of several species of tinamou, has published

some interesting sketches, from which the following concerning the present species is selected:—

This bird has no cover but the giant grasses, through which it pushes like a rail, and wherever the country is settled it soon disappears. It is solitary in its habits, con-



FIG. 22. — *Rhynchotus rufescens*, Perdiz grande, l'Ynamba.

ceals itself in the grass very closely, and flies with great reluctance. I doubt if there is anywhere a bird with such a sounding flight as this; and I can only compare the whirr of its wings to the rattling of a light vehicle driven at great speed over a hard road. From the moment it rises till it again alights, there is no cessation in the rapid vibration of the wings; but, like a ball thrown by the hand, the bird goes gradually sloping towards the earth, the distance it is able to accomplish at a flight

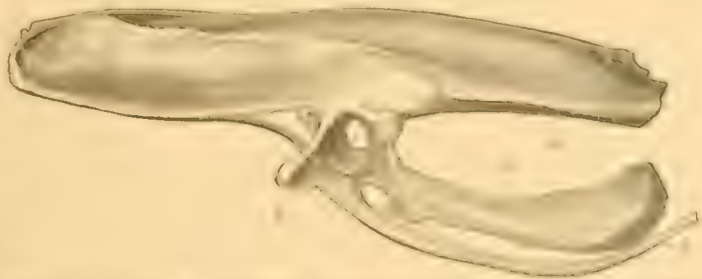


FIG. 23.—Pelvis of *Tinamus robustus*; *a*, acetabulum; *il*, ilium; *is*, ischium; *p*, pubis.

being from fifteen hundred to two thousand yards. This flight it can repeat, when driven up again, as many as three times, after which the bird can rise no more. The

call is composed of five or six long notes, with a mellow, flute-like sound, and so impressively uttered and sweetly modulated, that it is, perhaps, the sweetest bird-music heard in the Pampas.

The tinamous are considered rather stupid birds, and Darwin relates of another species, *Nothura major*, which is smaller, has a short bill, and no tail, that a man on horseback, by riding round and round in a circle, or rather in a spiral, so as to approach closer each time, may knock on the head almost as many as he pleases. The more common method is to catch them with a noose, or little lasso, made of the stems of an ostrich's feather, fastened to the end of a long stick. A boy on a quiet old horse will frequently thus catch thirty or forty in a day.

The smallest species is the Ynambu carapè (*Tuoniscus nanus*) from Brazil and Paraguay, it being only six inches long. It has no rectrices, but the coverts are dense silky, and greatly elongated so as to form a kind of a train. It seems to be still more unable to keep up a continued flight than the *Rhynchotus*; but little is known of its habits beyond Azara's account.

The foregoing birds, together with most of the species composing the family, belong to the group Tinaminae. In the martineta (*Calopezus elegans*) we have a representation of the Tinamotinae. Mr. Hudson dissected a specimen, and found a most extraordinary structure of the intestinal canal, which he describes as divided near the stomach into a pair of great ducts that extend almost to the entire length of the abdominal cavity, and are thickly set with rows of large, membranous, clam-shaped protuberances. Externally, the martineta, from size and mottled plumage, somewhat resembles the *Rhynchotus*, but is less reddish, and has a shorter bill, while its head is ornamented with a long, slender crest, "which, when excited, the bird carries direct forward, like a horn." Mr. Hudson remarks further that it is found in the northwestern portion of the Plata States, and south to the Rio Negro of Patagonia, frequenting the elevated table-lands, where patches of scattered dwarf scrub occur among the close thickets, and subsisting on seeds and berries. They go in coveys of from half a dozen to twenty individuals, and, when disturbed, do not usually take to flight, but start up one after another, and run off with amazing swiftness. They are extremely fond of dusting themselves.

ORDER.—GASTORNITHES.

In March, 1855, it was announced to the French Academy of Sciences that M. Gaston Planté had found in the conglomerate underneath the plastic clay at Bas-Meudon, France, a leg-bone of a gigantic bird, to which Mr. Hébert gave the name *Gastornis parisiensis*, "in order to indicate both the name of the discoverer and the locality where it was found." Shortly after, a thigh-bone was discovered, only three metres distant from the place where the leg-bone had been found. These remains, from the lowest eocene beds, were conscientiously studied by several savants, but the great difference in their conclusions did not throw much light upon the affinities of the bird. Mr. Hébert, Milne-Edwards, and Lemoine came to the conclusion that *Gastornis*—or rather its legs—showed relationship to the Lamellirostres, or the duck order. Valenciennes referred it to the neighborhood of the albatrosses, while Lartet and Owen demonstrated some points of resemblance to the waders, particularly the rails.

Recently additional material was discovered by the indefatigable Dr. Lemoine, of Reims, France, who has been enabled to describe two other species of *Gastornis*, *G. minor* and *G. edwardsii*, the former, however, from the fragment of a leg-bone only,

while numerous bones, and fragments of bones, of the latter, have been preserved. Both were found in lower tertiary deposits near Reims, and from the same geological horizon as the typical species, and in 1883 L. Dollo announced a thigh-bone from the same formation in the neighborhood of Mons, Belgium. Upon these fossils is based the restoration represented in the accompanying cut, in which the shaded portions indicate the parts which have been found. The most unique and remarkable character of the bird is said to be the distinctness in the adult bird of the sutures between the different bones of the skull, since in all other known birds these bones are anchylosed, and the sutures obliterated. This feature alone justifies the view that *Gastornis* is a peculiar type of at least ordinal rank, which accordingly has been attributed to it here. On the other hand, we cannot assign it a place very remote from the dromæognathous birds, with which the pelvic remains and the anterior extremities seem to indicate relationship. It may be that here is a representative of the ancestral stock from which flamingos, screamers, and ducks have sprung, or rather a form which takes the same position to the latter forms as do the *Crypturi* to the *Gallinaceous* birds. The true position of this type is impossible to make out at present, however, and it has therefore been placed at the end of the series called *Dromæognathæ*.

Before closing the chapter of the *Dromæognathous* birds we may mention a few fossil remains which seem to belong to this group, the greater abundance of which during former geological periods is evident.

Professor Brandt has described a gigantic egg found in an old watercourse on the steppes of southern Russia. It had a capacity of about forty-two hens' eggs, and showed distinct struthious characters. He called the supposed bird *Struthiolithus chersonensis*. It may have been related to *Gastornis*.

The *Diatryma giganteum*, from the coeene of New Mexico, was described by Professor Cope from a tarsus-metatarsus discovered by himself. "The characters of its proximal extremity resemble in many points those of the order *Cursores* (represented by the *Struthionidæ* and *Dinornis*), while those of the distal end are, in the middle and inner trochleæ, like those of the *Gastornis* of the Paris basin. Its size indicates a species with feet twice the bulk of those of the ostrich." The discovery introduces this group of birds to the known faunæ of North America recent and extinct, and demonstrates that this continent has not been destitute of the gigantic forms of birds heretofore chiefly found in the faunæ of the southern hemisphere.

LEONHARD STEJNEGER.

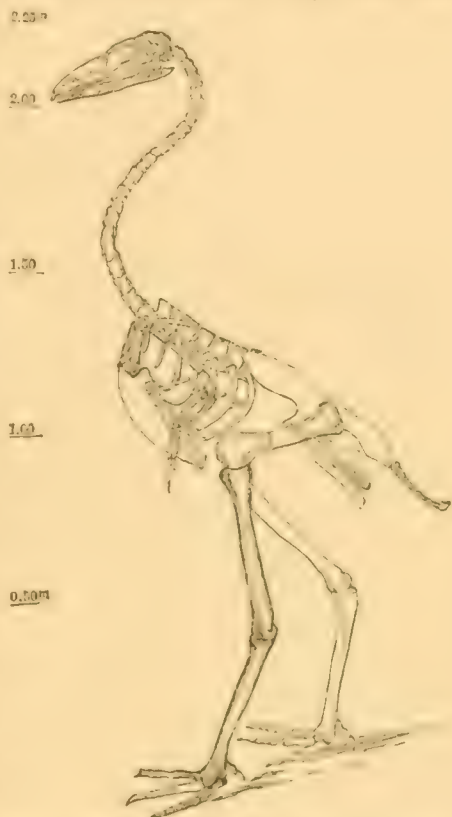


FIG. 24.—*Gastornis edwardsii*, as restored by L. Dollo.

SUPER-ORDER II. — IMPENNES.

This group, which, for reasons given further on, we here propose to treat as a superorder equivalent to the Dromæognathæ (ostriches, etc.) and Euornithes (including the rest of the living birds), has suffered a curious fate under the hands of ornithologists. Although one of the most distinct and peculiar divisions within the homogeneous bird-class, its position among the other groups has, until lately, been a very subordinate one.

Linnaeus did not even recognize the penguins as a separate genus. He placed one of these fin-winged species together with the swift-flying sun-birds, or tropic-birds, while another was ranked with the albatross. Brisson, the great contemporaneous ornithologist, however, made both those species types of separate genera, the latter of the genus *Spheniscus*, the former he called *Catarractes*. They were shortly after combined, by Forster and Gmelin, with other species into the genus *Aptenodytes*. The efforts of Cuvier and the ornithologists of his age resulted in the cutting up of Linnaeus's 'families,'—as his 'ordines' were styled at that time,—into several orders, the Natatores, among which the penguins had been placed, being divided in Pinnipedes (Steganopodes), Macropteres (Longipennes), Serrirostres (Lamellirostres) and Brachypteres (Pygopodes), and among the latter were placed the divers, auks, and penguins as genera of equal rank. A decided progress was made by Illiger in 1811, who divided the 'order' Natatores in six families, the last being the Impennes, which only included the genus *Aptenodytes*. But when Vigors in 1825 established the families ending in *idae*, the penguins were again included among the 'Alcidae.' Bonaparte, soon after (1831), made them the types of the family Spheniscidae, a position they held for nearly forty years without any serious challenge, as even Huxley failed to recognize their true position, assigning them, as he did, a place as a 'family' of equal taxonomic value with the plovers, cranes, gulls, etc. G. R. Gray had placed the penguins between the auks and the guillemots, consequently between two groups the typical species of which (the razor-billed auk, and the common guillemot), by many prominent ornithologists of the present day, are regarded as not even generically distinct; but it was not before he (in 1871) repeated this masterpiece of systematical perversity, that it became evident to all that the true relationship of these remarkable birds had been grossly misunderstood. Nevertheless, the rank of 'order' was all that could be afforded at the time, and it is not until very recently that it has been set clearly forth that the penguins, notwithstanding the keel on their breast-bone, are as remote from the other Carinatae (birds with keeled sternum) as these are from the ostriches, if not more so.

We have discussed this point at some length because of the interesting parallelism it presents with the fate of the Struthious birds, which at times also have been treated as a genus merely under different families, or orders even (Cursores; Otididae), until the truth of their distinctness was recently acknowledged. The assertion of Professor Huxley, that the extinct great auk (*Plautus impennis*) "shows itself to be an *almost* intermediate form" between the penguins and the auks, for a short while prevented the full recognition of the broad gap between the former and the rest of the living birds, but recent investigations show quite an opposite result.

In 1883 Professor Watson, in the seventh volume of the Report on the Results of the Challenger Expedition, presented an excellent "Report on the Anatomy of the

Spheniscidæ," from which, on account of the importance of determining the relationship of the higher group of birds, we shall quote freely in the following.

The vertebral column is characterized by the opisthocœlous character of the dorsal vertebræ, a character which, judging from the frequency of its occurrence in the two groups, is more truly reptilian than avian, and by the mobility of the dorsal vertebræ upon one another, and the absence, even in the adult, of that complete ankylosis between the dorsal and lumbo-sacral vertebræ on the one hand, and of the latter with the pelvic bones on the other, which obtains in the majority of birds. The opisthocœlous character of the vertebræ shows itself for the first time in the third dorsal; the cervical and the two first dorsal vertebræ being saddle-shaped. The succeeding dorsals differ in having the anterior surfaces rounded and globular, while their posterior surfaces are deeply concave. The lumbo-sacral portion of the vertebral column never becomes ankylosed with the pelvic bones, not even in the adult (Fig. 25). The pubis does not coalesce with the ischium, except where it enters the acetabulum.

The uncinate processes of the ribs are exceptionally large, and are only connected with the ribs by articulations, never becoming ankylosed with them as in the majority of birds.

The shoulder-blade (Fig. 26) is remarkable for its enormous size and its great width posteriorly, and the coracoid bone for its great strength. The most characteristic feature of the wing, as a whole, is perhaps the great amount of compression exhibited by all its bones, offering, when the wing-paddle is carried forward while swimming, the minimum resistance to the surrounding water. Furthermore, the movements permissible between the different bones are much more limited than in other birds—so much so that flexion and extension in the joints beyond the



FIG. 26. — Scapula of *Catharactes*.

These articulations, however, admit of a very considerable amount of rotation, converting the wing into a screw-like blade. The wings are never used as oars, but are brought into use alternately. The metacarpal consists of a single bone, which shows, however, the three elements of which it is composed. The first or radial metacarpal is destitute of any phalanx, and the pollex is consequently absent; the second finger has two phalanges, and the third only one.

The legs are less modified than the wings, but the tarso-metatarsus presents features which serve at once to distinguish that bone from the corresponding skeletal element of any other group of birds, being altogether shorter and broader than in these, with the single exception of the genus *Fregata*. From *Fregata*, however, as from all other birds, the penguin is distinguished by the clearly-defined separation of the metatarsal elements, the shafts of which are differentiated from one another, while in other birds these bones are indistinguishably fused together. Of the other bones, only the patella is remarkable, it being very large and wedge-shaped, with a greatly developed groove for the tendon of the ambiens muscle. Four toes are always present, the hallux being directed forward.



FIG. 27. — Right METATARSUS of *Catharactes*.

It has been suggested to me, Professor Watson further says, that the large development of the cutaneous muscles in these birds is probably a means whereby water



FIG. 25. — Pelvis of *Catharactes demersus*, dorsal view.

may be readily expelled from the interstices of the plumage so soon as the bird quits the water. Were it otherwise, in the low temperature of the Antarctic region, which the majority of these birds inhabit, the plumage would soon be frozen into an icy mass, the high temperature of the bird being of itself insufficient to obviate this, although assisted by the great development of the subcutaneous fatty layer, which far exceeds in thickness that of the corresponding structure in the member of any other group of birds, and recalls to mind the fatty deposit or 'blubber' of the seals and cetaceans.

The cutaneous system is thoroughly characteristic of the group, and differs from that of every other order of birds, in respect of the uniform distribution of the feathers over every part of the integument, and in the consequent absence of the bare tracts or apteria met with in other birds. The feathers, which are narrow and rigid, each possess an aftershaft. The remiges are not distinguishable from the surrounding feathers, but the rectrices are clearly differentiated.

ORDER V.—PTILOPTERI.

The superorder Impennes only comprises one order, the Ptilopteri, and the order again only one family, the SPHENISCIDE, the remnant of a group of birds, which, at an earlier date of the earth's history probably played a more important rôle than nowadays, when they are represented by only a few genera with hardly more than twenty species and subspecies.

Being adapted in the highest degree to the life in the water, the penguins represent among the birds the seals among the mammals, and curious indeed are the many features in which the two groups show parallel developments both in structure and habits, and particularly striking is the analogy with the eared seals, which chiefly inhabit the southern hemisphere, like the penguins, the distribution of which is exclusively confined to that part of the globe. It is a significant fact that the penguins are totally absent from all seas washing the shores of continents or continent-like islands, where no members of the Struthious superorder are now living, or have existed during the present geological period.

Like the fur-seal and its allies, the penguins pass the greater time of their lives on the ocean, heedless of storm and waves; down into the deep they go in pursuit of their food, and down they go into the quiet regions never stirred up by any hurricane, if the surface is getting too turbulent, though it must be hard weather indeed when a penguin goes in search of shelter, for he enjoys the wildest surf and loves the roaring gale. The swimming of the penguins is quite peculiar, and differs widely from the same movement as performed by all other swimming and diving birds. It has already been remarked that the paddle-shaped wings are brought in motion alternately, thus acting like a screw, but while in other birds the legs also come into play at least as accessory propulsive organs when the bird is diving, these organs in the penguins only act as a rudder, except when swimming on the surface of the water.

Neither are the legs very well adapted for rapid locomotion upon land, for the leg proper is almost wholly included within the skin of the body, and the foot is broad and clumsy, and the metatarso-phalangeal articulations so stiff that the whole tarsus is applied to the ground when the bird is walking, a condition unknown among other birds. The penguins are plantigrade, and their peculiar upright position when on land is due to that unique arrangement. It is mainly for the purpose of propagation that their legions go ashore a short season every year, enlivening the desolate rocks

and islands of an ocean seldom visited by other men than the sealer, and whaler, and the few fortunate naturalists who are permitted to see for themselves that peculiar animal life of that distant region, while we will have to content ourselves with what we can learn from the best of their accounts.

We recognize three different types of penguins, represented by the king penguin, the jackass penguin, and the rock-hopper, three well-defined groups of generic, or perhaps, rather, super-generic rank, which we shall call *Aptenodytes*, *Spheniscus*, and *Catarractes*.

The largest and one of the oldest and best known forms is the king penguin, the type of *Aptenodytes*, a genus easily distinguished by the size, and the length and slenderness of the bill, which is slightly arched, with which are associated a great number of anatomical characters; for instance, the persistence throughout life of the intermaxillary suture, the absence of a complete coracoid foramen for the transmission of the nerve to the middle pectoral muscle, the absence of any differentiation of syringeal from the adjoining tracheal rings, the presence of a tracheal septum, etc. With the *Aptenodytes* proper are here associated the members of the group usually called *Pygoscelis*, which have the bill stouter and more feathered, and the tail longer.

Best known is *A. longirostris*, the king penguin of the Falkland Islands, Kerguelen Island, and some other rocks and islands in the Antarctic Ocean. The color of the back is a mixture of slate-color and black, the under parts of the body white, head and throat black, a stripe from behind the eyes, down the sides of the neck, yellow, as is also the anterior part of the latter. The nearly related *A. patachonica* is larger, the base of the lower mandible and the tarsus more feathered. The accompanying plate represents *A. longirostris*, in regard to which Professor Moseley's criticism of another drawing is equally applicable. He says: "In the figure the birds' heads are drawn as if held horizontally. This is unnatural. The head and neck should be stretched out vertically, quite straight, with the tips of the beak pointed directly upwards." The same gentleman says that the king penguin stands as high as a man's middle, and when disturbed, made a loud sound like 'urr-urr-urr.' At Marion Island he obtained an egg which was of a uniform chalky white, pyriform in shape, and measuring 4.4 by 3.0 inches.

Dr. J. H. Kidder had good facilities of observing *A. papua* at their breeding-places on Kerguelen Island, and has given a very interesting account of his experience (Bull. U. S. Nat. Mus. No. 2), from which we take pleasure in copying the following: "No living thing that I ever saw expresses so graphically a state of *hurry* as a penguin, when trying to escape. Its neck is stretched out, flippers whirring like the sails of a windmill, and body wagging from side to side, as its short legs make stumbling and frantic efforts to get over the ground. There is such an expression of anxiety written all over the bird; it picks itself up from every fall, and stumbles again with such an air of having an armful of bundles, that it escapes capture quite as often by the laughter of the pursuer as by its own really considerable speed."

The jackass penguins (*Spheniscus*) have received their name from their voice, which is said to be very like the braying of donkeys. Their bills are straight and moderately short, but very stout and deep; the tip of the upper mandible is hooked, and that of the lower one truncate. Of anatomical characters the great development of the transverse temporal crest, the relatively slight curvature of the zygomatic arch, and the relative great length of the metatarsus, are among the more noteworthy features. Several species are known, of which the Australian *S. minor*, with white throat and without any dark collar, probably requires recognition as a separate genus, Bonaparte's

Eudyptula, on account of several important anatomical characters, among which is the absence of a tracheal septum.

The South African species, *S. demersus*, is one of the oldest known members of the order. It is slate-colored above, white underneath; a face-mask, offset from the rest of head by a broad white band, is blackish, and so is a narrow collar which continues down along the sides of the body, a dark stripe separated from the dark color of the back by a continuation of the white band of the head.

Professor Moseley, of the 'Challenger' expedition, gives the following account of a visit to a rookery of this bird at Seal Island, Cape of Good Hope. "It is a mere shelving rock, on which it is only possible to land on very favorable occasions. The birds here nested on the open rock, which was fully exposed to the burning sun and occasional rain. There was not a blade of grass on the rock, but it was covered with guano, with little pools of filthy green water. The birds nested under big stones, wherever there was place for them. Most of the nests were, however, quite in the open. The nests were formed of small stones and shells of a *Balanus*, of which there were heaps washed up by the surf, and of old bits of wood, nails, and bits of rope, picked up about the ruins of a hut which were rotting on the island, together with an old sail, some boat's spars, and bags of guano, evidently left behind by guano-seekers. The object of thus making the nest is no doubt to some extent to secure drainage in case of rain, and to keep the eggs out of water washing over the rocks; but the birds evidently have a sort of magpie-like delight in curiosities. *Spheniscus magellanicus*, at the Falkland Islands, similarly collects variously colored pebbles at the mouth of its burrow. Two pairs of the birds had built inside the ruins of the hut.

"All the birds fought furiously, and were very hard to kill. They make a noise very like the braying of donkeys, — hence their name; they do not hop, but run or waddle. They do not leap out of the water like the crested penguin, when swimming, but merely come to the surface and sit there like ducks for a while, and dive again."

A nearly allied but quite distinct species, *Spheniscus magellanicus*, easily recognized by the double black band across the breast, is found at the southern end of South America, and is particularly well known from the Falkland Islands and South Georgia. An extremely interesting account of this species, which also is known as the jackass penguin, and its habits at the latter locality, was published last year by Dr. Will, who, during a year's sojourn at the German polar station there, 1882-'83, enjoyed unusual opportunities for the study of these birds. We translate his account in full, as it probably is the most complete description of the habits of birds the home of which is so remote from regularly inhabited localities.

"Much more droll than the ferocious looking 'rock-hopper' and the solemn king penguin, is the jackass penguin; which in size (about 70 cm.) agrees with the former.

"The area covered by our excursions embraced six colonies, one of which was occupied by thousand of penguins; these, together with the frequent occurrence of these animals on the beach at the station, afforded good opportunity for studying thoroughly these queer birds, so singularly adapted for aquatic life.

"At the beginning of October the penguins were almost exclusively seen on the beach, crowded together and taking it easy after the copious meal, some of them in a standing position, others laying down with the head under one of the wings. Before long, however, they became more lively, and, tottering over the snowy slopes in long rows, went in search of the higher parts of the valleys opening into the bay, apparently most pleased with grass-elad and flat ground.

"A colony of penguins presents many interesting features during the nesting. The breeding grounds are mostly completely razed, the grass having been torn off for nesting purposes, so that everywhere the soil is bare between the irregularly strewn nests, and converted by rain and the droppings of the animals into a malodorous puddle. The nests are very rudely built, some by taking advantage of an already existing hummock after biting off the grass; others consisted only of a shallow cavity trampled into the ground, and surrounded with small pebbles, and particularly with grass-roots and moss which the bird pulls out with the bill.

"The building of the nests does not occur without furious fights. Every opportunity to steal grass and moss from unwatched nests (usually one of the mates is sitting in the nest while the other carries the building materials to the spot) for use in their own nest is seized upon, and then the depredators, who do not limit their pillaging to their own colony, are pursued with blows and pecks of wings and bills.

"We found the first eggs about the end of October, and usually only two are laid; if taken away, however, or stolen by the skuas (*Stercorarius antarcticus*) two other eggs may again be laid, but these are then always smaller. They vary considerably in size, the longer diameter being from seven to nine centimetres. The white has a bluish gloss, the yolk is orange, the shell very thick. The eggs are of considerable practical importance, as a great number may be collected in a short time without difficulty, although the taste is rather coarse.

"The breeding requires on an average six weeks, and is performed alternately by both parents. They sit on the eggs like other birds, and can only be removed from the nest by force, in which case their conduct is extremely ludicrous, as they defend themselves, blowing like geese, with the bill wide open, and, arising slightly, peck at the hand which dares encroach upon them. Pushed off the nest, the bird runs away as fast as possible, returns very soon, however, and jumping, both feet at a time, into the nest, looks foolish and bewildered at finding it empty; after searching all around within and outside the nest, until finally it dawns upon its mind that it has been robbed, the penguin lifts its head, giving vent to its grief by a doleful and discordant scream. When hearing the screeching of the plundered birds one may imagine being removed to a goose-pasture.

"The young ones are guarded and fed with the utmost care; the broad paths are alive with a never-ceasing swarm of going and coming birds engaged in bringing food. The old ones feed out of the crop; the young take the food from the bill of the old ones.

"Toward the end of the breeding season, at the beginning of March, the old penguins are very lean, presenting, on the whole, an unusually miserable appearance during the molt which occurs shortly after the young ones have exchanged their gray down for the first plumage. They generally leave the colony at that time, retiring with the young ones to some sheltered place, if possible in the vicinity of a rivulet, where they await the molt.

"On shore the penguins move only slowly and clumsily if not attacked; they remain unmoved if approached quietly, gazing with curiosity at the intruder, and may be driven for hours like a flock of geese. When attacked, however, they defend themselves by striking violently with the wings, but finally try to escape by lying down on the belly, rushing away by means of both feet and wings, moving the latter as when they are swimming. Their speed is so great that the pursuer only with difficulty can overtake them, particularly on snow-fields. I have repeatedly measured the dis-

tance between the impressions made by the wing in the snow, and found it to be, on an average, twenty-seven inches.

"The water is their proper element, to which the whole structure of the body and the smooth scale-like plumage is adapted. Standing on shore they plunge into the rising wave, and dart through the water like a shot, by means of the wings only. The speed and impetus may easily be tested by fixing a long line to the bird, and then



FIG. 24.—*Cataractes demersus*, rock-hopper.

letting it off into the water. The shock felt when it has run the line out is quite considerable. The bird reappears at some distance from land to breathe, when it immediately again dives, continuing its flight under water.

"The greater part of the day is spent at sea, the fauna of which yields the voracious birds an abundant supply of food. They return to the shore before dark. Shoals of penguins may often be seen, when on their way towards the shore, alternately jumping clear out of the water and then diving again. If the attention of such a flock be attracted by any foreign object, for instance, a boat, the whole company will stop and lie quiet on the water for a moment, stretching their necks far out, but continue

immediately, as if ordered, jumping and diving in a different direction. Such excursions of larger parties seem not to be the rule, however; they return usually simultaneously to their station singly or in small numbers."

It is interesting to observe that the habits of the same species on the Falkland Islands have been modified considerably on account of the permanent residence of man in the vicinity of the breeding grounds, for Captain Abbott remarks that, in the neighborhood of the settlement of Stanley, the burrows run in to a considerable distance, "on account, I conclude, of their being so often robbed of their eggs, which are taken out by means of a piece of iron hoop fastened to the end of a pole."

The accompanying cut gives a good idea of the remaining members of the order, the rock-hoppers, *Catarractes*, also known as *Eudyptes*, easily recognized by their elegant yellow superciliary crests and the short bill, with the upper jaw of a characteristic oval form. Two species are generally admitted, *C. demersus* (*catarractes* and *chrysocome*) and *C. chrysolophus*, the latter being the 'macaroni' of the sealers; but it seems as if the birds referred to the former, the true rock-hoppers, may be separated according to the different localities, Falkland Islands, Kerguelen Island, New Zealand, and Tristan d'Acunha, in several forms of at least sub-specific value. A few short extracts from Professor Moseley's excellent account may be found acceptable to complete the picture of this singular order of birds: "It is impossible to conceive the discomfort of making one's way through a big rookery. You plunge into one of the lanes in the tall grass, which at once shuts the surroundings from your view. You tread on a slimy, black, damp soil composed of the bird's dung. The stench is overpowering, the yelling of the birds perfectly terrifying. The nests are placed so thickly that you cannot help treading on eggs and young birds at almost every step. A parent bird sits on each nest, with its sharp beak erect and open, ready to bite, yelling savagely, 'caa, caa, urr, urr,' its red eye gleaming, and its plumes at half-cock, and quivering with rage. No sooner are your legs within reach than they are furiously bitten, often by two or three birds at once—that is, if you have not got on strong leather gaiters, as on the first occasion of visiting a rookery, you probably have not. At first you try to avoid the nests, but soon find that impossible; then, maddened almost by the pain, stench, and noise, you have recourse to brutality, and the path behind you is strewn with the dead and dying and bleeding. But you make miserably slow progress, and, worried to death, at last resort to the expedient of stampeding as far as your breath will carry you. I always adopted the stampede method in rookeries. These penguins make a nest which is simply a shallow depression in the black dirt, scantily lined with a few bits of grass, or not lined at all. They lay two greenish-white eggs about as big as duck eggs, and both male and female incubate. This penguin is called 'rock-hopper' from its curious mode of progression. The birds hop from rock to rock with both feet placed together, scarcely ever missing their footing."

Little is known as yet as to the geological history of the penguins, except that it dates back to the upper eocene at least, since fossil bones (humerus, coracoids, and metatarsus) of a gigantic form, *Palæudyptes antarcticus* have been found in strata of that age on New Zealand. This form stood from six to seven feet high, or higher than an average man! We have here a distinct evidence of the great age of the group, as might also be inferred from their remoteness from all other known birds. Their relations seem to be with the other schizognathous Natatores, rather than with any other, but the exact affinities are very obscure, for, as Professor Newton remarks, there is perhaps scarcely a feather or a bone which is not diagnostic.

LEONHARD STEINER.

SUPER-ORDER III.—EUORNITHES.

With the above name I have designated the rest of the existing birds. This super-order, therefore, embraces all living birds except the Dromæognathæ and the penguins. After these two groups are removed, there remains a vast number of very differently organized forms which, however, by intermediate links and connections on all sides, show greater relationships *inter se* than with any of those treated of on the foregoing pages.

The characters of this assemblage, as a whole, are rather of negative nature, though this statement may be little more than a play of words, since the absence of a certain feature is just as 'positive' a character in one group as is its presence in another. The phrase only means that, while we are familiar with the general characters of the bird-class, and while, from the previous account, we have learned the chief characters of the groups removed, we consequently now should know the peculiarities of the last group without any further characterization. A brief summary may nevertheless be useful.

The Euornithes are not dromæognathous, and, I need not say, their jaws are not possessed of teeth; the two mandibular halves are firmly united in a median symphysis; the head of the quadrate bone has two facets; the sutures of the skull disappear entirely in the adult; the dorsal vertebræ are saddle-shaped, and more or less firmly united; the sacral vertebræ are anchylosed with the pelvic bones, of which the ilia and ischia are anchylosed behind, thus forming an ilio-sciatic foramen; the tail is short, and the last vertebræ fused into a pygostyle; the wings, when in rest, are folded up, the bones lying more or less parallel to the main axis of the body; the scapula forms an angle with the coracoid, and not an arch; the hand has a free pollex; three metatarsal elements are never separately distinguishable; the feathers are distributed over certain pterykæ with interlying apteria.

The exact relationship of the present superorder to the two foregoing ones is by no means obvious, since it may well be disputed whether the so-called schizognathous "Natatores," on the one hand, are nearer related to the penguins than are the gallinaaceous birds to the ostriches, on the other. All the evidence tends to show, however, that the three groups separated very early, but our present material is too defective to allow any trustworthy speculations as to the probable process. Fossil Euornithes are by no means rare, however; but they are mostly from more recent strata, and nearly all belong to still existing types, in some instances of more generalized features, but the 'connecting links' are still missing. The search for fossil birds has, especially in France, unearthed many interesting facts concerning the geological history of the Euornithes and their former distribution, and the discovery, in deposits near Paris, of several tropical and particularly African forms, for instance, *Trogon* and *Leptosomus*, are extremely interesting as compared with the later arctic and sub-arctic faunas of the same latitudes during the glacial periods. But though the Euornithic forms originated during an earlier geological epoch, the present day is emphatically the era of the Euornithes.

ORDER VI.—CECOMORPHÆ.

It is particularly among the 'swimmers' and 'waders,' the Natatores and Grallatores of the old systems, that the modern investigations into the structure and the affinities of birds have made a sad havoc, entirely revolutionizing our ideas as to the

mutual relationships of the water birds. Their position and sequence has consequently been completely changed, and the aspect of that part of the system is quite upset. Ornithologists of the old school will have some difficulty in locating themselves.

Instead of the two old orders, Natatores and Grallatores, or three with the addition of the Herodiones, the modern researches have revealed four centres of relationship, which may be styled Pluvialiformes, Anseriformes, Ciconiiformes, and Pelecaniformes,—the three latter forming the desmognathous, the first-mentioned group the schizognathous series. The latter series more especially comprises the birds which usually constitute the orders Pygopodes, Longipennes and Limicolæ, the two first mentioned being here merged into Cecomorpha, according to Professor Huxley's view. The arrangement may not be regarded as final, however, for there are reasons to suspect that it will be necessary, ere long, to divide the schizognathous swimmers into three orders, Eretmopodes for the first two superfamilies of the present arrangement, Tubinares for the superfamily Procellarioideæ, and Pluviales for the rest of the members of the two orders.

The fact is, that not only are the gulls very nearly allied to the auks, but their affinities with the Grallæ, through the plovers, are unmistakable. On the other hand, the grebes seem to be only distantly related to the other 'Pygopodes,' and the puffins and albatrosses similarly so to the 'Longipennes' or gulls. But there is one feature of more novel systems which we are not willing to adopt, viz., the position of the plovers at the base of the series as the most generalized forms. That in these birds some anatomical features of quite a generalized character remain during the whole lifetime, while in the gulls they are only present in the embryonic state, is no argument in favor of the view of the latter being only a degraded branch of the former, since we find ample proof all through the class that one or more characters of the ancestral stock may survive in a highly specialized group, while they may be lost comparatively early in another, which, on the whole, has departed only slightly from the common ancestor. Our knowledge of these birds is as yet particularly deficient concerning the degree of affinity between the different forms, and it will therefore be found that in the following we have given the generally adopted sequence the benefit of the doubt.

As stated above, the members of this order are strictly schizognathous; another cranial feature is that they are schizorhinal. Their palmate feet will serve to distinguish them externally, a feature which, among the Grallæ, is only found in the avocets, which are not easily confounded with the birds here in question on account of their



FIG. 20.—Skeleton of *Colymbus cristatus*.

long legs and feet, features which none of them share. The grebes have only lobate feet, like the phalaropes and the gallinules, which, however, have well-developed rectrices, not possessed by the grebes.

The grebes already in their external appearance manifest aberrant characters, which secure for them a separate position as COLYMBOIDEÆ (with exclusion of the loons, the *Urinatoridae*, which, though having some general resemblance to the former, differ in many very essential points). The grebes have no supraorbital depression for the nasal glands; the number of cervical vertebræ (15 to 19) is unusually large; the sternum is quite different, the xiphoid process being shorter than the lateral ones, and notched behind; the pelvis is also singularly long and narrow, and the diverging pubic bones rather peculiar; the ambiens muscle is absent, and the formula of the leg muscles is BX, while in the loons the ambiens is present and the formula is ABX; only one carotid is present; the primaries are eleven, a very unusual number; true rectrices are absent; the toes are lobate. In all these and several other features do they differ from the loons, with which they share the long cnemial process of the tibia in front of the knee. The head is, in a good many species, most singularly adorned during the breeding season by bright-colored ruffs and crests, which give the birds a very odd appearance, still further increased by the broad, flattened toes, and the total absence of an external tail. The grebes look extremely old-fashioned; that is, they impress us as if their grotesque figures were only survivors from by-gone periods, which we are used to imagine populated by all sorts of fanciful creatures.

Only one family, COLYMBIDÆ, also known as Podicipidæ, with about thirty species referable to a few genera, composes at present this superfamily. As a group they are nearly cosmopolitan, though mainly confined to the temperate regions of both hemispheres. Their habits present many strange features quite in keeping with their curious aspect. They are among the most expert divers, but, in contradistinction to the penguins, never use the wing in diving, the large, curiously-shaped feet performing the propulsion alone. The extreme compression of the tarsus, to use Macgillivray's words, and the arrangement of the toes, enable the feet to be brought forward without receiving almost any opposition from the water, and in giving the propelling stroke, the blade, thus folded up, is expanded into a broad, lobate paddle. Among flying birds none are so completely water birds as are the grebes. They very seldom leave the water, and must be pressed very hard before they take to the wing; nothing but the direst necessity will force them on land, for not only do they feed entirely on the products of, and in, the water, but they sleep and even breed on the surface of that element. Their nests are floating masses of wet vegetable material, which the parents secure by diving; this swimming abode, which they anchor to some reed or grass, is sometimes constructed over deep water, and the eggs are often hatched when partly lying in the water. When out of the shell, the young has not far to walk; he looks a few moments over the edge of his water-drenched cradle, and down he goes with the expertness of an old diver. The grebes have a peculiar faculty of regulating their floating in the water; usually they lie quite high, but if alarmed, and fearing danger, they can press themselves down under the surface, so that only the long, thin neck and the back of their flat body is visible above. They feed chiefly upon fishes, and may, therefore, in some localities, become injurious. Their skin, with the peculiar silky feathers, is in great demand for trimmings, ladies' hats, muffs, etc.

The grebes are migratory in the colder parts of their range, and spend the breed-

ing season exclusively on fresh water. Only during the migrations and winter-time are they to be found at sea.

The crested grebe (*Colymbus cristatus*), the species represented in the cut, is one of the largest of the genus. It has formerly been considered an inhabitant of this continent, but, as it seems, quite erroneously, it being confined to the temperate parts



FIG. 30. — *Colymbus cristatus*, crested grebe.

of the Old World, including Europe. The western grebe (*Elaenoides forsteri*) inhabits the western and southwestern portion of the Nearctic region. It is characterized by its extremely elongated neck, long and slender bill, and by the absence of parti-colored ruffs or crests. *Podiceps dominicanus*, from South and Central America, represents in the New World the well-known European dab-chick (*P. fluvialtilis*), both very small species, destitute of crests or ruffs, the latter represented all over the Old

World by several geographical variations. The American genus, *Podilymbus*, is particularly characterized by its high and stout bill, and by the bristly feathers of the forehead. The American dab-chick, *P. podiceps*, is common in eastern North America.

We have here to consider a small group of birds, consisting of perhaps not more than four species, and constituting a separate superfamily which we have called HELI-ORNITHOIDEÆ, though by no means convinced that this is the best place that could be assigned to them. They are more usually referred to the neighborhood of the rails, but as this position does not satisfy us better, the view of the late Professor W. A. Forbes has here been followed in placing them nearer to the grebes.

With the latter, the fin-foots, or sun-grebes, as they have also been called, agree in the form of the bill, and like them they have lobated toes, which, among other things, however, differ in having the middle toe decidedly longer than the outer one. Their plumage is not dense and glossy like that of the grebes, from which the fin-foots differ most essentially in having not less than eighteen well-developed tail-feathers. Another point characteristic of the pterylosis of these remarkable birds is that the feathers are without an aftershaft. The head is small, and the neck very thin and narrow.

The fin-foots are still a great puzzle to ornithologists, for not only is their structure imperfectly known, but information concerning their habits is extremely scanty. Their geographical distribution is not less perplexing; for one genus, with one species, *Heliornis fulica*, inhabits South America, two species of the genus *Podica* are peculiar to Africa, while a third one is at home in eastern Asia, a distribution which offers certain points of analogy to that of the darters.

The South American fin-foot inhabits rivers of the Brazilian empire and other eastern states on the Neotropical continent. It is about the size of the European dab-chick, of a brownish olive color above, with head and upper neck black; it is buffy white underneath; neck, throat, and a postocular stripe pure white. Very characteristic are the broad and distinct black bands which cross the joints of the yellow feet. The 'picapare,' as it is called by the inhabitants, prefers shadowy and quiet rivers, even those of the deep virgin forests, feeding upon fishes, water insects, and seeds. It is said to sit for hours on a branch overhanging the water and half submerged, but diving is only resorted to in danger or when wounded. Two naked young ones are hatched in December. Heard from a distance, the voice is said to resemble the barking of a small dog.

The following superfamily, the ALCOIDEÆ, is of a very varied appearance, and is in many respects of great importance, not only on account of the great number of differing forms of which it is composed, and the zoological interest connected with them, but also because the enormous number of individuals of several species make them a notable object in the economy of many a tribe of mankind inhabiting the inhospitable regions surrounding the north pole. In fact, the members of this superfamily are distinctive of the northern circumpolar fauna, and not a single one is found on the southern hemisphere, nor does a single species inhabit any part of the tropical zone. As a consequence of the circumpolar distribution, all the genera and nearly all the species occur in America.

We distinguish two very well defined families, the Urinatoriæ and the Aleidæ. Externally they differ especially by the former having four, the latter only three toes. A very striking anatomical difference is the presence in the former of a very powerful enemial process of the tibia in front of the knee-pan, another being that the former have an ambiens muscle which the latter lack.

The URINATORIDÆ, or loons, are usually by systematists associated more or less intimately with the grebes, though, it appears, with no good foundation, being, however, on the whole, the most generalized forms of the present superfamily, and therefore nearest related to the ancestral stock from which both grebes and auks have started. Even in coloration the loons are less specialized than the other members of the superfamily, since in the latter the young ones at once assume the plumage of the adult birds, while the young loons first have to pass a more or less speckled stage.

Only a single genus, *Urinator*, with five distinct species, of which the red-throated diver (*U. lumme*) is the most common and best-known form, constitutes the family. They inhabit high latitudes and propagate always on fresh water, in the neighborhood of which they deposit their dark olive-colored eggs in a rude depression in the ground, but they retire to the sea as soon as the breeding is over. They are solitary birds, and seldom more than one pair occupy a lake. Their voice is loud and harsh; heard during a dark and stormy night, it sounds like cries of people in danger or distress; during the daytime their *ka, kakara* which they repeat when flying, is a fitting song to the accompaniment of the roaring surf, and has procured for the red-throated species the distinction of being styled by humorous Norsemen "the nightingale of Lofoten." There, as elsewhere, where the divers are at home, they have given rise to many popular tales and superstitions. Thus it is said about the loon (*U. imber*) that it was first made without legs, but that Nature, becoming sensible of her mistake, got into a pet, and flung a pair of legs after the bird, which fully accounts for their singularly posterior situation. Even the old naturalists were full of these fables, and Pontoppidan, the celebrated Norwegian bishop and author of the last century, relates how "the immer is never seen to come ashore, excepting in the week before Christmas, wherefore the fourth Sunday in Advent is called by the people Immer Sunday." He also tells that the bird has two holes under its wings, wherein it deposits its eggs, which it carries about with it, hatching them with as much facility on the water as other birds do on dry land.

The auk family (ALCIDÆ) consists of a number of birds of varied appearance, nearly all of which are of a somewhat clumsy build, with rather large heads, the legs placed far back, and only three toes, the hind one being invariably absent. The sexes are colored alike, and the young ones differ only slightly. They have a double molt, and the breeding plumage is usually somewhat different from that worn during the rest of the year, but the change is mainly confined to the face and the anterior parts of the lower surface.

The family, as a whole, is circumpolar, although several of the forms have quite a restricted distribution, especially those peculiar to the North Pacific Ocean. It is noteworthy that, at present, only two genera are peculiar to the Atlantic and adjoining parts of the Arctic Ocean, viz. *Alca* and *Alle*, while not less than seven genera are confined to the Pacific side. Three genera are circumpolar.

Though closely resembling the black-and-white auks and guillemots proper, as far as coloration is concerned, the little sea-dove (*Alle alle*), 'rotge,' as it is commonly called by all the sailors visiting its breeding places in the Atlanto-Arctic Ocean, or king-awk, as it is styled by the Norsemen, seem to be of a somewhat different structural type. We shall here only mention the peculiar shape of the bill, which is entirely unique even in this family of birds, which excels in curiously shaped bills of the most different pattern. These can be traced back to a few types, however; but the bill of the bird in

question represents quite a type of its own, being nearly gallinaceous in form, and remarkable for an exceedingly short gonys. That this form is said to have only one carotid, while the other Aleidæ have two, is perhaps of less moment, though we must remember that the grebes were similarly specialized.

The sea-dove is truly hyperborean in its breeding habits, being found in incredible numbers along the island shores of the western Arctic Ocean. Nordenskjöld gives a very graphic description, from which we extract the following. The rotge occurs only sparingly off the southern part of Novaja Zemlja, and does not, so far as I know, breed there. The situation of the land is too southerly, the accumulations of stones



FIG. 31.— *Uria ringria*, spectacled guillemot.

along the sides of the mountains too inconsiderable, for the thriving of this little bird. But on Spitzbergen it occurs in incredible numbers, and breeds in the talus a hundred to two hundred metres high, which frost and weathering have formed at several places on the steep slopes of the coast mountain sides. These stone heaps form the palace of the king-auk, richer in rooms and halls than any other in the wide round world. If one climbs up among the stones, he sees at intervals actual clouds of fowl suddenly emerge from the ground, either to swarm round in the air or else to fly out to sea, and at the same time, those that remain make their presence underground known by an

increasing cackling and din. The birds, circling in the air, soon settle again on the stones of the mountain slopes, where, squabbling and fighting, they pack themselves so close together that from fifteen to thirty of them may be killed by a single shot. Their food, which they secure by diving, consists of crustaceans and worms. The single bluish-white egg is laid on the bare ground without a nest, so deep down among the stones that it is only with difficulty that it can be got at.



FIG. 32. — *Plautus impennis*, great auk.

The three genera, *Uria*, *Alca*, and *Plautus*, like the foregoing, black with white breast and belly, and white fore-neck during the winter, constitute another group characterized by their more or less compressed bills, upon which the feathering of the head protrudes quite a considerable distance. The first-named genus contains the two different species of guillemots, murrelets, or lomvies (*U. troile* and *U. lomvia*) represented in the Pacific and Atlantic Oceans by separate varieties, particularly remark-

able for their enormous number on the northern bird-rookeries, and for the variability in color of the single large and pear-shaped egg, which may be found from nearly uniform white to deep sea-green, heavily spotted and singularly streaked with black and brown. The accompanying cut represents a puzzling variety, the so-called spectacled guillemot (*U. ringia*), which is identical with the common species except in possessing a white ring round the eyes, and a white streak behind them running backward above the ear-coverts. While rather scarce, and not occurring in all places where the common guillemot breeds, it, on the other hand, is never found except where the latter occurs. The status of the variety is therefore not settled, though most ornithologists, perhaps, at present regard it as a mere individual variation. In regard to the cut, it may be remarked that the shoulder feathers ought to be more uniform black.

Next in order come the true auks, both characterized by the transverse grooves on the bill, and both confined to the North Atlantic Ocean. The first is the razor-bill, (*Alca torda*), the other the great auk (*Plautus impennis*), with its many names, the *gejr* or *gare-fowl* of the Icelanders, the northern penguin, the celebrated 'wingless bird,' which formerly inhabited both shores of the Atlantic, in its northern temperate parts, but, contrary to the popular notion, not the Arctic Ocean. This famous bird, famous because of its tragic fate, bred numerous on Newfoundland and on the Funk Islands during the last century; in 1844 the last survivors of the last colony in Iceland were killed. Now its skin and bones and eggs are regarded as the most precious treasures of the museums; and long monographical accounts are published, showing the exact number of these relics, the museums in which they are found, and the history of each single specimen as far as it can be traced. The last list (1884) is by Professor W. Blasius, who enumerates 76 authenticated skins or mounted birds, 68 eggs, 9 more or less complete skeletons, besides numerous skulls and detached bones. Half the skins and most of the bones are probably of American origin, but not more than five skins are in American museums; among these is the one which Mr. Robert L. Stuart recently bought for \$625, and presented to the museum in New York. The *gare-fowl* is of special interest, since it is the only one of the order which is known to have been deprived of the power of flight, and which therefore became exterminated by the agency of man. It was a kind of representative, in northern waters, of the flightless Antarctic penguins, by which name it was principally known on the American side of the Atlantic during the last century, penguin being probably only a corrupt derivative of *pin-wing*, though usually derived from the Latin *pinguis*, fat. We need not here repeat the differences of the true penguins, but will only call attention to the fact that the great auk was provided with normal remiges, and that it was only the smallness of the wings which made them unfit for flight.

The black guillemots (*Cephus*) form a small group of Arctic birds which in their history exhibit too little to detain us further. Through a number of rather obscurely known forms (*Brachyramphus*, etc.,) peculiar to the Pacific Ocean, we are led to the curiously ornamented pigmy auks of the same ocean, conspicuous among other characters for their white-colored eyes; and to the much larger sea-parrots or puffins. Of the former may be mentioned the least auk (*Simorhynchus pusillus*), a beautiful little sea-bird, not so large as a robin, and with a peculiar knob on top of the bill near its base, which is shed annually when the breeding season is over. Two other species of the same genus (*S. pygmaus* and *cristatellus*) are somewhat larger, but look very odd from the red or orange bill, the many white crests and moustaches, and the peculiar tuft of feathers on the forehead, bent forward in exactly the same man-

ner as the feather crest of the California quail. All these inhabit principally the rocky shores of the Aleutian Islands, breeding in deep holes of the rocks and between the stones. Then we have the rhinoceros auk (*Cerorhina monocerata*) with its peculiar deciduous horn on top of the bill. We may also mention the parrot auk (*Cyclorhynchus psittaculus*), because of its most extraordinary bill, of which Cassin says that "it seems to obtain a maximum of oddity amongst the queer bills of this family of birds, the whole affair looking as if it might be a nose of wax, badly pinched and jerked to the disadvantage of the under mandible," but especially because we wish to warn against the often-repeated theory, that the knife-shaped or falcate under mandible, together with the compressed upper bill, are thus adapted for prying open bivalve molluscs; nobody has seen them open shells in that way, and, in fact, the food of these birds consists only of fish-fry, crustaceans, cephalopods, and small molluscs which they can swallow whole, as I have verified by numerous dissections.

Nearly related to the foregoing is another small group of auks consisting of only two genera and three well-defined species, viz., the puffins, or, as the German ornithologists sometimes call them, the masked divers, a name deriving its application from the white face 'mask,' quite a distinctive feature in these birds; and not at all alluding to the grotesque, high, extremely compressed, transversely grooved, and gayly colored bill, much less to the deciduous nature of the basal parts of the bill, a peculiarity which was not known until the French naturalist, L. Bureau, made the discovery in 1876. By examining the bill of breeding birds we will find that it consists of two differently colored parts, — a terminal one, with several transverse grooves, and a basal, purplish, yellow, or green part separated from the former by a furrow, and again subdivided by other furrows into several distinct pieces; nearest to the feathering of the forehead is a somewhat swollen orlet, with numerous fine pits, like the top of a thimble; all these parts are hard like the tip of the bill, but the corner of the mouth is surrounded by a soft wattle, the 'rosette;' and in the genus *Pratercula*, soft wattles are also found under and above the eyes, the latter being the so-called 'horns.' Towards the end of the breeding season the furrows between these basal plates become deeper, until finally they are entirely detached, when they fall off, giving place to a brownish soft membrane or 'cere.' Upon closer examination we now find that the outline of the bill has changed considerably, it is much lower where it joins the feathering, and the latter occupies now the place of the orlet with the numerous pits. Shortly after midwinter these basal parts commence to swell and harden, becoming brighter colored when the breeding season draws near; the feathers on the orlet drop off, the pits indicating where they were originally inserted. Simultaneously with this shedding of the bill, the double molt of the plumage takes place, but the only difference between the breeding attire and that of the rest of the year is that the mask is white, against gray or black, and that in the genus *Lunda* at that time an elegant tuft of long, pendant straw-yellow plumes is developed behind the eyes. Both sexes are absolutely similar, and the shedding of bill and plumes identical in both.

The North Atlantic Ocean is inhabited by the common puffin (*Pratercula arctica*) and its different geographical varieties. Its Pacific representative is the horned puffin (*P. corniculata*) with the base of the bill canary-yellow. More peculiar to the latter ocean is the tufted puffin (*Lunda cirrhata*) which occurs from the Farralones, outside of San Francisco Bay, all along the northwestern coast and across the Aleutian Islands to Kamtschatka. The present writer has had good opportunity of observing the latter species while prosecuting ornithological researches on the Kamtschatkan

Islands two years ago, and takes, therefore, the liberty to introduce a sketch of his experience with this little known but very interesting species, extracted from an advanced sheet of his report. "With the beginning of May the 'toporok' (plur. 'toporki') as it is called by the Russians, makes its appearance at the islands, an event to which the natives, heartily tired of their winter food, the salted seal-meat, look forward with great impatience. On a bright afternoon we therefore started, a gay picnic party, consisting mostly of Aleuts and their wives or lady friends, for the small islet Toporkoff, about three miles off. During our passage out only a few birds were seen, as it was no 'land-day,' but I was assured by the natives who had watched them that they would be in on the following morning. The toporki and their allies show during this season, previous to the breeding, the peculiarity of appearing regularly — as it seems — in great abundance near shore on one day, while next day they all disappear, staying away on the high sea for two days, when again they take a 'land-day.' Toporkoff Island, which has received its name from the fact that it is one of the greatest rookeries of these birds, consists of a horizontal plateau about thirty feet above the level of the sea, rising abruptly from a beach fifty to two hundred feet broad. The plateau is covered with a thick hummocky sod, which in every direction is perforated by the numberless nest holes dug out by the toporki. When evening set in, the picnic party went home, leaving us men to pass the night on the island. The ornithological spectacle at daybreak the following morning was unique and grand. Hundreds and thousands of *Lunda cirrhata* crossed and recrossed the island, coming from all directions, and disappearing on the opposite side, in order to return again and again. A wonderful sight! The black birds with their conspicuous white face-mask, the long, floating, yellow ear-tufts, bent like the horns of a ram, with large red-and-green-colored beaks and red legs, looked like fantastical creatures of the tropics rather than inhabitants of the less extravagant north. Like black specks they rose from the horizon, heading for the island; the nearer they came, the larger they grew, until they passed over us, disappearing as specks again on the other side, and when once started, nothing seemed to be able to bring them out of their straight course. These clumsy looking, puffy birds possess, nevertheless, a very rapid flight, so that, at the first acquaintance, one is rather apt to shoot behind them; but they do not fly very high. The natives take advantage of this difficulty of making a sudden turn, and throw a net, fastened to a long pole, in the way of the flying bird, which thus falls to the ground and is captured. When I turned out, the Aleuts were already in their places, waiting for the rush. By the dawning day we discern a small flock of toporki surrounding each of them, stretching their necks and pointing their bills heavenward in quite an unaccountable manner. A closer inspection reveals that these are only decoys: empty skins held in position by a stick thrust into the ground. It is 'land-day' indeed, and we only wonder that the innumerable birds do not suffer collision during their airy sailing, for they are thick as May-flies round an electric light. Suddenly the nearest Aleut raises his net; a bird, unable to turn aside, runs into it with a clash, falls to the ground, and in a twinkling is added to the heap of other unfortunates with broken necks."

Though in their external appearance extremely unlike the Alcoideæ, the birds constituting the superfamily LAROIDEÆ, or the gulls, are intimately related to them. Their wings are long; the feet are placed more under the middle of the body, which therefore is carried nearly horizontal, instead of upright, they have usually four toes, the three anterior ones palmate. But the characters of the plumage agree pretty

closely, and so does the anatomical structure too. Without going further into detail, we only mention that, in contradistinction to the foregoing groups, the members of the present one have the part of the frontals occupying the space between the depressions for the nasal glands widened to a flat surface instead of being a sharp ridge. As to the palatal characters, may be noticed the presence of basipterygoid processes. The superfamily is equal to the former order, Longipennes, minus the Tubinares, which here constitute the superfamily Procellaroideæ, a separation to be closer discussed under the latter.

Two, three, or four families are recognized in this group, according to the value assigned to distinguishing characters by the different authors, viz., two when skimmers and terns, on the one hand, are placed against jagers and gulls on the other; three when the two latter are deemed sufficiently distinct to form separate families; four when the two former are also allowed family rank. Notwithstanding the common usage, the present writer is unable to detect even a sub-family distinction between the gulls and the terns, while he is willing to regard the skimmers as constituting such a division. The jagers he will treat as a distinct family, however.

This family, called the STERCORARIIDÆ, consists only of a few species—about half a dozen—which exhibit a series of characters not shared by the rest of the members of the superfamily, being in many respects a remarkable and highly interesting group of birds. One of the most obvious features is the so-called ‘cere,’ covering the basal part of the beak above the nostrils; this cere is by some authors said to be soft, others again say that it is only a hard thin lamella, while the fact seems to be that both are correct, but that it is soft or hard according to the season. In my opinion this cere is the homologue of the ‘nasal cuirass’ of the puffins, and is shed in precisely the same manner, as I have a specimen from Kamtschatka which seems to be in the process of shedding, a discovery here announced for the first time. The pterylosis deviates somewhat from that of the Laridæ, the feather tracts being considerably broader, and the arrangement of the inferior tract different. Of anatomical features we will only mention that the Stercorariidæ have only one notch on each side of the posterior margin of the breast bone, while the Laridæ have two, and that in the former the cæca are very much longer.

We distinguish two genera, the members of which disagree not only in external appearance, but also in their habits. The first one consists of the great skuas (*Megalestris*) strong, large, dusky brown-colored birds, with the bearing of a large gull. The bill is strong, and the tail is nearly even. One species inhabits the North Atlantic (*M. skua*) while two representative forms are found in the antarctic seas. Dr. J. H. Kidder had the opportunity of observing the habits of one of the latter (*M. antarcticus*) while connected with the U. S. Transit-of-Venus Expedition to Kerguelen Island; and as his interesting sketch of its habits illustrates the peculiarities of the genus, we introduce an extract as follows: “It was at first taken for a hawk by all of us; its manner of flight, watchfulness of the ground over which it flew, and habit of perching on spots commanding a wide view, all suggesting this impression. It was, indeed, difficult to believe the evidence of my own senses when I found a web-footed bird avoiding the water, and preying solely, so far as my observation extended, upon other birds. When any of the party went out shooting, he was pretty sure to be followed by one or two ‘sea-hens,’ as the sealers call them, and had often to be very prompt to secure his game before it should be carried off in his very presence. November 21, in order to settle the question whether they attack and kill their own game when it is

unhurt, Mr. Stanley and I dug up, by the aid of the dog, a well-grown and nearly-fledged young bird (supposed to be of *Majaqucus aquinoctialis*), as large as an ordinary domestic fowl. A pair of skuas being near at hand, watching our proceedings, I threw the young bird up into the air, so that it flew some distance and alighted perhaps two hundred yards away from us. One of the skuas immediately flew up to it, and killed it by repeated blows upon the head with its beak; the other remaining at some distance, on guard, as I at first thought, but, as afterward appeared, afraid of its mate, for, while we stood watching the first skua eating its capture (nearly as large as itself), the other approached by degrees, uttering short, plaintive chirps, but not daring to share in the meal. When, after a few minutes, we drove them off, the abdomen of the petrel had been torn open and its entrails partly devoured. As a general rule, its habits are terrestrial, and on the few occasions when, probably after poor success in hunting, I have seen it alight in the water, it has held its wings up perpendicularly, like a butterfly, as if afraid of wetting them. At the pairing season, this trick of holding up the wings becomes quite a prominent characteristic. Two will alight upon a knoll, quite near together, holding their wings perpendicularly in the air, and set up a vociferous cackling. The note is loud, harsh, and hoarse, suggestive of the cry of the gull. The nest is a shallow cavity in the long grass (*Festuca*), lined sparingly with grass stems, and always in a dry spot. The old birds make it very lively for the egg-hunter, attacking him on opposite sides with great vigor and determination, and keeping up an outcry that is really appalling. Seeing a skua fly by the house one day, apparently going somewhere in a great hurry, I snatched up a revolver (no gun being at hand) and followed him. He was going to join the female on her nest, as I suspected, and when I approached both attacked me as usual. I succeeded in killing the male, but emptied the revolver at the female without success, and was kept standing for certainly twenty minutes, pelting the enraged bird with stones as she swooped down at my head, with the two eggs in plain sight, but not daring to pick them up."

The members of the genus *Stercorarius* are arctic and sub-arctic, being of smaller size than the foregoing, and characterized by having the middle pair of tail feathers protruding considerably beyond the others. The Pomarine jaeger (*S. pomarinus*) is of a somewhat rare occurrence, but is easily distinguished by the middle tail feathers, which are obtuse at the end, having the portion beyond the others twisted so that the webs stand nearly vertical instead of lying flat. The long-tailed jaeger (*S. longicaudus*) is another northern species, characterized by its enormously elongated and pointed central tail feathers, and its blue tarsus. It is more an inland bird, often inhabiting moors and swamps in the mountains, and to a great extent feeding upon field-mice and lemmings. The best-known species is the so-called Richardson's jaeger, known among fishermen and sailors as the 'boatswain,' 'teaser,' 'dung-hunter,' etc., the first name referring to the pointed central tail feathers as 'marling-spikes,' the office emblem, so to speak, of the boatswain; the third one alluding to the belief, which at one time even was shared by the men of science, that these birds feed on the dung of gulls and terns, while the second name fitly illustrates one of the remarkable habits of these birds, to be mentioned below, and which has secured for it its scientific name *S. parasiticus*. Though written more than fifty years ago, William Macgillivray's spirited account of the habits of this bird is still unsurpassed, so we may be excused for reprinting it here: "The sea-birds are on wing, wheeling and hovering all around, vociferous in their enjoyment, their screams mingling into one harsh noise, not less

pleasing for a time than the song of the lark or blackbird (*Merula*). Every now and then a tern dips into the water, and emerges with a little fish in its bill, which it swallows without alighting. In the midst of all this bustle and merriment, there comes gliding from afar, with swift and steady motion, a dark and resolute-looking bird, which, as it cleaves a path for itself among the white terns, seems a messenger of death. But a few minutes ago he was but a dim speck on the horizon, or at least some miles away, and now, unthought of, he is in the very midst of them. Nay, he has singled out his victim, and is pursuing it. The latter, light and agile, attempts to evade the aggressor. It mounts, descends, sweeps aside, glides off in a curve, turns, doubles, and shoots away, screaming incessantly the while. The sea-hawk follows the frightened bird in all its motions, which its superior agility enables it to do with apparent ease. At length the tern, finding escape hopeless, and perhaps terrified by the imminence of its danger, disgorges part of the contents of its gullet, probably with the view of lightening itself. The pursuer, with all his seeming ferocity, had no designs upon the life of the poor tern; and now his object is evident, for he plunges after the falling fish, catches it in his descent, and presently flies off to attack another bird. In this way the marauder makes his rounds, exacting tribute from all whom he thinks capable of paying it, and not sturdy enough to resist oppression. The teaser never fishes for himself on such occasions, although his organization seems to fit him for aquatic rapine, even more than that of the tern or gull. The pirate can neither dive nor plunge, but it swims with ease, and sits lightly on the water, like a gull. The instinct that enables it to select a bird that has something to spare for its wants is truly surprising. I have never seen it give chase to a gull or tern, without accomplishing its purpose. It is not a singular case that an animal should be destined to live by the labors of others of different species; but in the class to which the pirate belongs there are very few instances of such an arrangement. It cannot, however, be said to live without labor, for the trouble of compelling its unwilling vassals to disgorge is apparently greater than what would abundantly supply it with honestly obtained food."

Before closing the history of this bird, we may remark that it breeds almost exclusively near fresh water, though, of course, not so very far from the sea, unless in the neighborhood of a colony of terns or gulls, likewise breeding at an inland lake. We have already, in the introduction, mentioned the remarkable dichromatism of this species, which has no connection with age, season, or sex, but which seems to be somewhat influenced by the geographical distribution, since the dark phase is the most numerous form in the southern part of the range, while in the highest north the bird with the whitish under side is the predominating, and possibly the only occurring.

In the next family, the *LARIDÆ*, the horny covering of the bill is continuous, there being no cere or separate piece overhanging the nostrils. The hind border of the sternum is provided with two notches on each side, and the caeca are short. The division in two sub-families has already been mentioned. The first one of these comprises the gulls and terns, which we, at present, can see no reason for separating, except as subordinate groups. The latter are usually of a slenderer build, and the nostrils are mostly placed in the basal half of the bill, while in the gulls they open near the middle, and furthermore, their bill is not hooked at the end, as usually in the gulls, but these differences are only those of degree, and they run nearly imperceptibly into each other. The popular notion as to the characters separating these two groups is that the gulls have an even tail, the terns a forked one; but while this mark holds

good in most of the forms, it is by no means reliable, since we have gulls with deeply forked tails, and both gulls and terns in which the tail is wedge-shaped or graduated.

The predominating color of the adult members of this sub-family is white with a gray mantle, varying in shade from the most delicate pearl gray to dark blackish slate, or nearly black, and the head is often more or less marked with black in summer. The seasonal change is not great, and affects chiefly the color of the head, which, in species with black hoods, turn white in winter, while the white-headed gulls usually get that part streaked with dusky during the same season. There are, however, several forms, both among gulls and terns, which are more or less dusky. The bills and feet are usually brightly colored, yellow or red, and the sexes are alike in color. The young ones, however, are very different from the adult, being mostly of a brownish-gray, spotted or streaked with dusky, and with dusky wings and tail, the bill also being dark.

The gulls inhabit the oceanic shores and inland lakes alike, though most species are truly marine, or nearly so, and as they are distributed all over the world, their

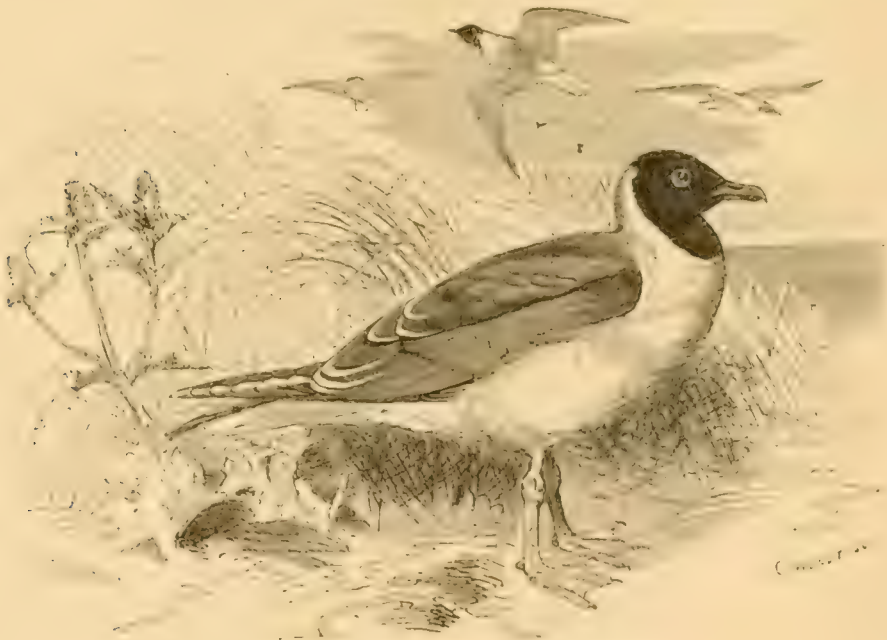


FIG. 33.—*Hydrocolæus ridibundus*, black-headed gull.

graceful form is familiar to everybody, whether he dwells near the coast or far in the interior. Our own shores of the two oceans are thickly populated by their noisy crowds, and on our large inland waters numerous colonies rear their black-speckled brood. We therefore need only refer to the accompanying full-page cut, to recall to our readers the fascinating view of a gull rookery with its ceaseless uproar, caused by the screaming and quarrelling birds, overnoising even the thunder of the surf. The black-hooded gulls, of which the cut illustrates a characteristic and well-known Old World representative (*Hydrocolæus ridibundus*), are still more clamorous, and their voice more penetrating, than that of their larger relatives (*Larus*), resembling, in fact, that

of the terns, which they approach both in general coloration, structure, movements, and habits. A not distantly related species, without black on the head, however, is the mackerel-gull of New Zealand (*H. scopulinus*), the 'tarapunga' of the Maori, which seems to be somewhat similar in habit to Richardson's jäger, just mentioned on a previous page, judging from Dr. W. L. Buller's account, which is to the following effect: "This pretty little gull is one of our commonest birds, frequenting every part of the coast [of New Zealand], and being equally plentiful at all seasons of the year. It is a bird of very lively habits, and its presence goes far to relieve the monotony of a ride over such dreary stretches of sand as the Ninety-mile Beach, and the coast-line between Wanganui and Wellington. At one time you will meet with a flock of fifty or more in council assembled, fluttering their wings, chattering and screaming in a state of high excitement; at another you will observe them silently winnowing the air, turning, and passing up and down at regular intervals, as they eagerly scan the surface of the water. Here you find them ranged apart along the smooth beach, like scouts on a cricket-ground; there you see a flock of them packed together on a narrow sand-pit, standing closer than a regiment of soldiers — heads drawn in, one foot up, 'standing at ease.' Then, again, if you observe them closely, you may see them following and plundering the oyster-catcher (*Heematopus*) in a very systematic manner. Nature has furnished the last-named bird with a long bill, with which it is able to forage in the soft sand for blue crabs and other small crustaceans. The mackerel-gull is aware of this, and cultivates the society of his long-billed neighbor to some advantage, he dogs his steps very perseveringly, walking and flying after him, and then quietly standing by till something is captured, when he raises his wings and makes a dash at it. The oyster-catcher may succeed in flying off with his prey; but the plunderer, being swifter on the wing, pursues, overtakes, and compels a surrender. The gentleman of the long bill looks gravely on while his crab is being devoured, and, having seen the last of it, he gives a stifled whistle, and trots off in search of another, his eager attendant following suit."

From the Antipodes we turn our attention towards the icy shores surrounding the North Pole, where one of the most beautiful species of the whole family of gulls has taken up his summer residence, and whence — even in winter — he only very seldom makes a visit to countries inhabited by civilized man. We refer to Ross's gull (*Rhodostethia rosea*), or the wedge-tailed gull, as it is also called, on account of the form of its tail. It is a rather small species, white, with a light pearl-gray mantle, and a very characteristic black collar round the middle of the neck; the white being suffused with a delicate peach-blossom red in the fresh bird, which gradually fades away after death. The bill is black, the feet are red. The history of this bird deserves to be given in detail, since it is also the history of how slowly our knowledge of the birds inhabiting the locality where it lives has advanced, and the efforts which have been made by heroic explorers to elucidate the mystery as to the true locality of the species. The first two specimens were obtained at Alagnak, Melville Peninsula, 69° 30' north latitude, by Sir James C. Ross, during the latter part of June, 1823, on Parry's second voyage. Since then a few birds were seen by some of the following expeditions. Accidental stragglers to southern countries were obtained in Kamtschatka, England, Farões, Heligoland, and six specimens found their way to European collections from Greenland. During the Austro-Hungarian 'Tegethoff' expedition, one was obtained off Franz-Josef Land, but was lost when the vessel was crushed in the ice, and Professor Nordenskjöld was fortunate enough to secure at the 'Vener's' winter quarters, where

in summer plumage, on July 1, 1879. None had been obtained by Americans, or had found their way to any American collection, though all our earlier expeditions had been on a sharp lookout for the rare and beautiful bird, until Mr. E. W. Nelson, the collector of the U. S. National Museum, brought home from Alaska a young one obtained at St. Michaels, Oct. 10, 1879. Three days earlier, in north latitude $71^{\circ} 50'$ north of Siberia, on the ill-fated 'Jeannette,' Mr. R. L. Newcomb shot two in autumnal plumage, and, during the drift of the vessel in the ice the following year, he secured specimens in the latter part of June; altogether he obtained eight birds. But when he had to leave the doomed ship, "when it was a question of saving their bare lives, and the necessities of existence which each one of the shipwrecked crew could carry had to be weighed literally by the ounce, Mr. Newcomb gallantly stuck to three of these birds, and brought them in safety across Asia and Europe to the Smith-



FIG. 34. — *Rhodostethia rosea*, Ross's gull.

sonian Institution." In the records of collecting, we can call to mind no similar instance of bull-dog tenacity, remark the editors of "The Ibis," when commenting upon the heroic deed. Finally, Mr. J. Murdock, naturalist of the Point Barrow expedition, collected a great number of adults and young during the latter part of September and the beginning of October, 1882, when flocks, evidently migrating, passed the Point, coming along the coast from the southwest. He sent home to the National Museum a greater number of specimens than had ever been observed before. For all that, nobody has yet found the breeding place, and no one has collected its eggs or its downy young, or observed its habits; nor have we any information concerning where it spends the winter. But the mystery is not so great as it was; Ross's gull has been found all round the North Pole, and it is safe to predict that it

breeds on the islands of that yet untrodden region, inhabited by several other species of birds, the breeding grounds of which have not been reached by the explorer and collector. In winter it probably follows the edge of the ice, thus avoiding the shores and the vicinity of man.

The gulls having already occupied more space than was originally allotted them, we will have only to mention the kittiwakes (*Rissa tridactyla* and *brevirostris*) populating the Arctic bird-rookeries, the dazzling white ivory-gull (*Gavia alba*) from the icy circumpolar regions, and the fork-tailed gulls, constituting the genus *Nema*, one of which, *N. sabinii*, inhabits the high north, while the other, *N. furcata*, a bird extremely rare in collections, is a resident of a probably very restricted area in the tropics, possibly of the Galapagos Islands alone.

Of those just mentioned, the kittiwake is perhaps most interesting, because of the immense number of birds composing their breeding colonies, an account of which will be of great interest, and we therefore take pleasure in introducing the following sketch, by Henry Seebohm, of one of those rookeries.

"The largest colony of birds which I have ever seen is that at Sværholt, not far from the North Cape, in Norway, on the cliffs which form the promontory between the Porsanger and the Lakse Fjords. It is a stupendous range of cliffs, nearly a thousand feet high, and so crowded with nests that it might easily be supposed that all the kittiwakes in the world had assembled there to breed. The number of birds has, however, been grossly exaggerated. If we estimate the surface of the cliff covered by the nests at about 640,000 square feet, and allow for each nest a foot in width and two feet and a half in height, we obtain a total of (say) a quarter of a million breeding birds. Supposing the non-breeding birds to be ten to one, surely a very high estimate, we only reach five and a half million birds. When a recent writer says that 'the number of individuals must amount to millions,' or thousands of millions, he is simply talking unmitigated nonsense, and obviously has no conception of what a milliard is. One milliard kittiwakes laid in a row, and touching one another, would reach twenty times round the world. But in spite of all this tall talk, the number is incredible. It is the custom to fire off a cannon opposite the colony; peal after peal echoes and re-echoes from the cliffs, every ledge appears to pour forth an endless stream of birds, and long before the last echo has died away, it is overpowered by the cries of the birds, whilst the air in every direction exactly resembles a snowstorm, but a snowstorm in a whirlwind. The birds fly in cohorts; those nearest the ship are all flying in one direction, beyond them other cohorts are flying in a different direction, and so on, until the extreme distance is a confused mass of snowflakes. It looks as if the fjord was a large chaldron of air, in which the birds were floating, and as if the floating mass was being stirred by an invisible rod. The seething mass of birds made an indelible impression on my memory; it photographed itself on my mind's eye, as such scenes often do."

The chief characteristic of the terns, as distinguished from the gulls, have already been given on a previous page. In their habits they resemble the gulls, especially the smaller species, but in the same way as their appearance and structure is, so to speak, a kind of intensification of the gull type; so are also their habits and peculiarities, like those of the gulls, in a maximized and intensified degree. Let us, for instance, mention only their curiosity. Thus writes J. F. Naumann, the famous German ornithologist, of *Sterna paradisica*, the arctic tern: "When something new happens, such a bird soon arrives, inspects it closely, and, fluttering over it, gives out a

cry that in a moment brings together quite a gathering, which, after having satisfied their curiosity, disperses by and by. If a new mound of earth be thrown up, or a handkerchief or a piece of paper be lost, or if they see a recently killed bird lying, or a captured one flapping its wings, immediately are they at hand, flutter and vacillate, screaming over the object of their admiration, and, when through gaping and tired of crying, fly off in different directions."

Did space permit, long and interesting accounts could be given of the terns, but we are compelled to dismiss them with but few words.



FIG. 35. — *Sterna tschegrava*, Caspian tern.

The terns exhibit in their flight some remote resemblance to the swallows, which, in connection with the usually deeply forked tail, has given rise to the name of sea-swallows, as they are called in many languages; while the elegance of their motions when on the wing has caused many an enthusiastic outburst both of poets and naturalists. "Light as a sylph," says Audubon, "the arctic tern dances through the air above and around you. The Graces, one might imagine, had taught it to perform those beautiful gambols which you see it display the moment you approach the spot it has chosen for its nest." The terns only seize their prey, which usually consists of small fishes, by darting headlong upon them from a considerable height, and the force of their sudden and dashing plunges is really astonishing. "The descent of a tern,"

to quote from Mr. William Brewster's excellent paper on the terns of the New England coast, "upon its victim is performed with inimitable ease and grace. The bird frequently disappears entirely beneath the surface, and occasionally even swims a short distance under water before reappearing." His description of the scene when a flock of terns have discovered a school of blue-fish is so animated and picturesque, that I feel justified in quoting once more: "Dozens dash down at once, cleaving the water like darts, and, rising again into the air, shake the salt spray from their feathers by a single energetic movement, and make ready for a fresh plunge. Every bird among them is screaming his shrillest, and the excitement waxes fast and furious. Beneath, the blue-fish are making the water boil by their savage rushes, and there is fun and profit for all save the unfortunate prey."

Though a group of considerable homogeneity, the Sterneæ comprise a few somewhat outlying genera, as the noddies (*Anous*), dusky of color, and the white terns (*Gygis*) pure white all over, both forms with graduated or wedge-shaped tails. Both are tropical, the latter especially inhabiting the islands of the South Atlantic and the Indian Ocean, Polynesia, and Australia, while numbers of the former genus also occur in the New World, a single species (*A. stolidus*) even belonging to the fauna of the United States. The genus (or rather super-genus) *Sterna*, includes about fifty species, among them our common terns, but is divisible into several more or less well-defined groups. Thus the bird represented in our cut (*Sterna tschegraya* or *caspia*), the largest species, is the type of *Thalasseus*, while the smallest species—for instance, our *S. antillarum* and the European *S. minuta*—form the group *Sternula*.

We now come to a small group of Laroid birds, remarkable for their curious bill, the lower mandible of which has been compared with a "short-handled pitchfork," and for their long wings, viz., the skimmers, the Rhynchopine, not less remarkable for their peculiar habits and their geographical distribution, parts of America, Asia, and Africa being inhabited by one species each. The American species (*Rhynchops nigra*), the black skimmer, or shearwater, as it is also called, which occurs on our east coast up to New Jersey, has found many excellent biographers and describers, from whom we only make two selections. Our immortal Wilson thus describes this singular bird: "The shearwater is formed for skimming, while on wing, the surface of the sea for its food, which consists of small fish, shrimps, young fry, etc., whose usual haunts are near the shore and towards the surface. That the lower mandible, when dipped into and cleaving the water, might not retard the bird's way, it is thinned and sharpened like the blade of a knife; the upper mandible, being at such times elevated above water, is curtailed in its length, as being less necessary, but tapering gradually to a point, that, on shutting, it may offer less opposition. To prevent inconvenience from the rushing of the water, the mouth is confined to the mere opening of the gullet, which indeed prevents mastication taking place there; but the stomach, or gizzard, to which this business is solely allotted, is of uncommon hardness, strength, and muscularity; far surpassing, in these respects, any other water bird with which I am acquainted. To all these is added a vast expansion of wing, to enable the bird to sail with sufficient celerity while dipping in the water. The general proportion of the length of our swiftest hawks and swallows to their breadth is as one to two; but in the present case, as there is not only the resistance of the air, but also that of the water, to overcome, a still greater volume of wing is given, the shearwater measuring nineteen inches in length, and upwards of forty-four in extent. In short, whoever has attentively examined this curious apparatus, and observed the pos-

sector, with his ample wings, long bending neck, and lower mandible, occasionally dipped into, and ploughing, the surface, and the facility with which he procures his food, cannot but consider it a mere playful amusement, when compared with the dashing immersions of the tern, the gull, or the fish-hawk, who, to the superficial observer, appear so superiorly accommodated."

Darwin observed the skimmer in South America. That excellent observer gives us the following account of its habits: "Near Maklonado (in May), on the borders of a lake which had been nearly drained, and which in consequence swarmed with small fry, I watched many of these birds flying backwards and forwards for hours together, close to its surface. They kept their bills wide open, and with the lower mandible half buried in the water. Thus skimming the surface, generally in small flocks, they ploughed it in their course; the water was quite smooth, and it formed a most curious spectacle to behold a flock, each bird leaving its narrow wake on the mirror-like surface. In their flight they often twisted about with extreme rapidity, and so dexterously managed, that they ploughed up small fish with their projecting lower mandibles, and secured them with the upper half of their scissor-like bills. This fact I repeatedly witnessed, as, like swallows, they continued to fly backwards and forwards, close before me. Occasionally, when leaving the surface of the water, their flight was wild, irregular, and rapid; they then also uttered loud, harsh cries. When these birds were seen fishing, it was obvious that the length of the primary feathers was quite necessary in order to keep their wings dry. When thus employed, their forms resembled the symbol by which many artists represent marine birds. The tail is much used in steering their irregular course."



FIG. 56. — Skeleton of giant fulmar.

It has already been hinted at, on a previous page, that the super-family PROCELLAROIDÆ might perhaps better constitute a separate order, Tubinares. Their differences from all the foregoing birds are many and important, and their affinities seem to be more with the Steganopodes and Herodiones than with the gulls or the auks, to some of which many of the petrels show a remarkable external and superficial resemblance. We will give their essential characters, as contrasted with those of the Laroideæ, in order to show this. The petrels are holorhinal, the gulls schizorhinal; the former have tubular nostrils, the latter normal ones; whenever a hind toe is present, it consists in the petrels, of one phalanx only, while, in the gulls, the normal number of two phalanges is always present, however rudimentary the toe; in the petrels, the great pectoral muscle is disposed in two quite separate layers, an arrangement unknown in the gulls, and the *pectoralis tertius* of the former is entirely unrepresented in the latter; the muscular formula of the legs in petrels is, as a rule, ABXY, a combination, so far as we know, never found in the gulls; the form

of the stomach and the characters of the cæca are entirely different in the two groups, and so are the characters of the plumages of the young (adult of both sexes, and young, except the Albatrosses, being alike); the number and color of eggs, etc., all points of special importance in settling the question of affinity. Some of the peculiarities are quite unique among existing birds; for instance, the tubular nostrils, the structure of the hind toe, and the form of the stomach,—features which should secure a distinct position for the group, it being, as mentioned above, rather probable that the Tubinares should be placed in the neighborhood of the Steganopodes and Herodii, notwithstanding the desmognathism of the latter, since the palate in the albatrosses, though yet schizognathous, shows a decided tendency towards becoming desmognathous, being, in fact, intermediate between these two categories of palatal structure. At all events, Professor Huxley's remark, that "the gulls grade insensibly into the Procellariidæ," has been shown, by the researches of Garrod and Forbes, to be entirely erroneous, since, from their investigations, it is evident, that the Procellarioideæ represent the rather specialized offshoot (in some features) of a very generalized ancestor, being certainly a group of considerable isolation, great antiquity, and consequently highly interesting to the systematic ornithologist.

We shall here adhere to the commonly accepted division of this group, in three families, Diomedidæ, Procellariidæ, and Pelecanoididæ; the first one characterized by the lateral and separate position of the nasal tubes, while the last is remarkable for the shortness of its wings and the total absence of a hind toe. The albatrosses have usually been regarded as three-toed, but, while one genus really has a minute external hind toe, the ossicles, or rudimentary bones of a fourth toe, have been found underneath the skin in the others; the toe proper, in all cases, consisting of one phalanx only. We cannot pass by in silence, however, the arrangement proposed by Garrod and Forbes, distributing the Tubinares in two primary groups, according to the presence (Oceanitidæ) or absence (Procellariidæ) of the leg-muscle Y (accessory semitenodinosus), and the corresponding absence and presence of colic cæca, together with a number of other characters: but we are not prepared to regard these features as so important as those which constitute the characteristic marks of the three families mentioned above, though, with Robert Ridgway, we are willing to admit the Oceanitinae as a sub-family under the Procellariidæ.

The first family, then, consists of the albatrosses (DIOMEDIDÆ), those long-winged ocean-birds, which, for hundreds and hundreds of miles, follow the vessels over the tropical and southern seas, circling about them monotonously day after day, picking up the offal, arousing the tired sailor's admiration by the power and endurance of their scarcely moving wings, which seem never to know or need a rest. One of the most important characters of the family has already been mentioned, viz., that the tubes by which the nostrils open outwardly are situated one on each side of the bill, and not more or less closely united on top of the culmen, as in the other families. Whether this feature is an old and generalized one, indicating the way by which, finally, the curious and unique 'double-barrel' on top of the bill was formed, or whether it represents an arrested development during embryonic life, cannot be discussed here. It can only be noted that the albatrosses, so far as color of plumage is concerned, seem to be more generalized than the rest, the young ones being decidedly different from the adults. On the other hand, they have reached a high degree of specialization in some respects; for instance, the proportionate great length of the upper arm-bone, the consequent enormous length and peculiar shape of the wing, and

the great number of secondaries. Formerly, two other distinctive marks were attributed to the albatrosses, viz., want of aftershafts, and lack of hind toe, but rudiments both of the former and of the latter have recently been proved to exist.

The longest and perhaps best known species is the wandering albatross (*Diomedea exulans*), the one represented by the accompanying cut, the largest water-bird in existence, and the bird with the greatest stretch of wing, some specimens being said to



FIG. 37. — *Diomedea exulans*, wandering albatross.

measure fourteen feet between the tips of the wings. The color is white, more or less waved, and vermiculated with blackish, the hand-feathers being black; the eye is brown, the naked ring round it light greenish, the bill pinkish white, and the legs of a light flesh color. Like all the members of the family, they are inter-tropical and sub-antarctic in their distribution, and it is a significant fact which should not be lost sight of, when discussing the affinities and genesis of the Tubinares, that the group reaches its greatest development and number of forms south of the equator.

No traveler has witnessed the albatross in the state of nature without expressing

his enthusiasm when describing its sailing flight. Says Dr. Bennett: "It is pleasing to observe this superb bird sailing in the air, in graceful and elegant movements, seemingly excited by some invisible power; for there is scarcely any movement of the wings seen after the first and frequent impulses are given, when the creature elevates itself in the air, rising and falling as if some concealed power guided its various motions, without any muscular exertion of its own." J. Gould is still more enthusiastic: "The powers of flight of the wandering albatross are much greater than those of any other bird that has come under my observation. Although during calm or moderate weather it sometimes rests on the surface of the water, it is almost constantly on the wing—and is equally at ease while passing over the glassy surface, during the stillest calm, or flying with meteor-like swiftness before the most furious gale; and the manner in which it just tops the raging billows, and sweeps before the gulfy waves, has, a hundred times, called forth my wonder and admiration. Although a vessel running before the wind frequently sails more than two hundred miles in the twenty-four hours, and that for days together, still the albatross has not the slightest difficulty in keeping up with the ship, but also performs circles of many miles in extent, returning again to hunt up the wake of the vessel for any substances thrown overboard." It is generally asserted that the albatrosses and petrels which follow the vessels are able to continue their flight without any rest, to speak of, for days and weeks, thus showing an almost incredible power of flight, and many interesting experiments with captured and marked birds are cited.

Of another species, the black-eyebrowed albatross, (*D. melanophrys*) Mr. Gould, for instance, says; "It is very easily captured with a hook and line, and, as this operation gives not the least pain to the bird, the point of the hook merely taking hold in the horny and insensible tip of the bill, I frequently amused myself by capturing specimens in this way, and setting them at liberty again, after having marked many, in order to ascertain whether the individuals which were flying round the ship at night-fall were the same that were similarly engaged at daylight in the morning, after a night's run of 120 miles; and this, in many instances, proved to be the case." Capt. F. W. Hutton, however, who has made the flight of these birds a special study, came to different conclusions and asserts that the cases where a single individual is found to follow a ship for any length of time are exceptions, and that the habits of the albatrosses are quite diurnal. "It is, I believe," he says, "the generally received opinion of naturalists that these birds, when seen for several days together, have never slept during the whole period, but have followed the ship night and day. To me, however, it appears incredible that any animal should be able to undergo so much exertion for so long a time without taking rest; and I hope to show that it is not necessary to suppose that it does do so. Mr. Gould says that birds caught and marked are generally seen next day; but such is not my experience. I have sometimes marked ten or twelve Cape-pigeons (*Daption capense*, one of the Procellariidæ) in a day, and seldom seen one again. Mr. Gould, however, is quite right when he says that sometimes a marked bird turns up after being absent for two or three days; and how can this be accounted for except by the theory of the birds constantly following the ship? A few certainly can be often seen flying under the stern at night. Still they are never numerous; and where there were fifty or a hundred birds in the daytime there are only one or two at night. I therefore believe that, although a few may follow a ship for a night, most of them sleep in the sea, and in the morning, knowing very well that a ship is the most likely place to obtain food, they fly high with the intention of looking for

one. Some find the ship that they were with the day before, some another one. In the latter case, if the second ship is going in an opposite direction to the first, they are never seen by the first again; if, however, the course of the two ships is the same, the bird might, very likely, lose the second ship, and rejoin the first, after a lapse of two or three days. A height of 1000 feet would enable a bird to see a ship 200 feet high more than fifty miles off, and often, although unable to see a ship itself, it would see another bird which had evidently discovered one, and would follow it in the same way that vultures are known to follow one another. This opinion is much strengthened by the fact that at sunrise very few birds are round the ship, but soon afterwards they begin to arrive in large numbers." The same author enlarges on the general history, especially the breeding habits of the albatross, a condensed account of which will be found very interesting. The wandering albatrosses are very common south of latitude 40° S. and monopolize nearly the whole of the Prince Edward's Islands and the south-east portion, or lee-side, as the sealers call it, of Kerguelen Island, to which places they retire to breed in October. The nest, which is always placed on high table lands, is in the shape of the frustrum of a cone, with a slightly-hollowed top, and is made of grass and mud, which the birds obtain by digging a circular ditch, about two yards in diameter, and pushing the earth towards the centre, until it is about eighteen inches high. In this nest the female bird lays one white egg, which is not hatched until January. It is asserted, upon the authority of Mr. Richard Harris, engineer of the Royal Navy, that the old birds leave their young and go to sea, and do not return until the next October. "Each pair goes at once to its old nest, and after a little fondling of the young one, which has remained in or near the nest the whole time, they turn it out, and repair the nest for the next brood." Hutton thinks that the old ones go to sea when the young are about three months old, and that the latter are nocturnal in their habits, and go down to the sea at night to feed, returning to their nests in the morning, though Harris's testimony is to the effect that the young during that period are unable to fly. Mr. C. J. Anderson has suggested that the young birds "live on their own fat" while the parents are absent, and asks: "If other animals can live for several consecutive months on their own fat, why not birds?"

The PROCELLARIIDÆ is the group richest in species, comprising, as it does, about seventy different forms, in size varying from that of a sparrow, as the stormy petrels (*Procellaria*, and *Oceanodroma*), to that of one of the smaller species of albatrosses, as the giant fulmar (*Ossifraga gigantea*). The most essential external characters are the tubular nostrils on top of the culmen, combined with long wings, and the presence of a small hind toe. *Inter se* the members of this family group themselves around several somewhat diverging centres, forming more or less separate groups; most interesting, as far as anatomical peculiarities are concerned, being the so-called sub-family Oceanitinae, which comprises four genera of small stormy-petrel-like birds, the most striking feature of which are the small number of secondaries (ten only), the booted or transversely scutellate, but never reticulate tarsus, the flat and depressed claws, the length of the tarsus, absence of colic cæca, presence of an *accessory semitendinosus* muscle, etc. Typical is Wilson's petrel (*Oceanites oceanica*), like a 'Mother Carey's chicken,' but with long, booted tarsus, and the webs between the toes yellow, and also belonging to the North American fauna, though its centre of distribution seems to be in the southern seas. It breeds, among other places, also on Kerguelen's Island, to which the following sketch of its breeding-places by Rev. A. E. Eaton

applies: "Carefully watching the birds flying to and fro about the rocks, we observed that they occasionally disappeared into crevices amongst piles of loose stones, and crept under loose masses of rock. Having meanwhile ascertained their call, we were able, by listening attentively, to detect the exact positions of several of these hidden birds. They were easily caught when the stones were rolled aside; but they were in couples, merely preparing for laying, and therefore we did not find any eggs." It may be remarked that the petrels usually are found in pairs in the holes before the breeding commences. Later, only one of the parents occupies the nest, while the other one brings food to the breeding mate during the night; after the chick is hatched, both parents stay away during the day, only visiting and feeding it after dark. "The egg," Mr. Eaton continues, "is laid upon the bare ground, within the recess selected by the birds, either in a chance depression formed by contiguous stones, or in a shallow, circular hollow excavated in the earth by the parent. Having found numbers of their nesting-places I will describe my method of searching for them. Whenever there was a calm night, I used to walk with a darkened bull's-eye lantern towards some rocky hillside, such as the petrels would be likely to frequent. It was best to shut off the light and keep it concealed, using it only in dangerous places where falls would be attended with injury, and progress in the dark was hardly possible, lest the birds, seeing it, should be silenced. On arriving at the ground selected, it was probable that storm petrels would be heard in various directions, some on the wing, others on their nests, sounding their call at intervals of from two to five minutes. Those on nests could be distinguished from others flying, by their cries proceeding from fixed positions. Having settled which of the birds should be searched after, a cautious advance had to be made in her direction, two or three steps at a time, when she was in full cry. As soon as she ceased, an abrupt halt was imperative, and a pause of some minutes might ensue before she recommenced her cry and permitted another slight advance to be effected. In the course of this gradual approach, the position of the bird might be ascertained approximately; but it had to be determined precisely, and to learn exactly where she was, she had to be stalked in the dark noiselessly. No gleam could be permitted to escape from the lantern. Loose stones, and falls over rocks,—to avoid them it was sometimes necessary to dispense with slippers, and feel one's way in stockings only, for should the petrel be alarmed once with the noise or the light, she would probably remain silent a considerable time. Now and then it would happen that, upon the boulder beneath which she was sitting being almost attained, the bird would cease calling. When this occurred, and many minutes elapsed without her cry being resumed, it was advisable to make a detour, and approach the rock from the opposite side, as her silence might be attributed to her seeing a person advancing towards her, and she would probably recommence her call as soon as he was out of sight. If she did not, a small pebble thrown amongst the rocks would usually elicit some sounds from her, as she would most likely conclude that the noise was being made by her mate returning to the nest. When the stone beneath which the bird was domiciled was gained at last, redoubled care had to be exercised. By stooping down, and listening very attentively, her position could be accurately ascertained. Then the lantern was suddenly turned upon her before she had time to creep out of sight, and her egg could be secured with the hand, or with a spoon tied on to a stick."

Among the *Procellariinae* several groups may also be distinguished: first, the small stormy petrels, 'Mother Carey's chickens,' as they are usually called.

Another group is represented by the genus *Prion*, very remarkable for its very peculiar and broad bill, which is provided with a fringe of lamellæ, somewhat similar to those of the ducks.

The well-known 'Cape pigeon' (*Daption capense*) also shows rudiments of lamellæ, but is rather referable to the next group, including the fulmars. The bird represented in the cut is the *Fulmarus glacialis*, already mentioned in the Introduction for its remarkable dichromatism. To this group also belong the giant fulmar (*Ossifraga gigantea*), from the southern seas, nearly as large as the smaller albatrosses, and dichromatic, like its northern relative. The last group comprises several genera



FIG. 38. — *Fulmarus glacialis*, arctic fulmar.

of shearwaters (which are characterized by a four-notched sternum), including the very remarkable genus *Bulweria*, which has a wedge-shaped tail, and the highly specialized muscular formula AX.

The third and last family of the Tubinares are the PELECANOIDIDÆ. In their external appearance they present a striking resemblance to several of the smaller auks, being adapted to the same mode of life, and this adaptation has not only affected their external characters, the length of wings, etc., but also some of their anatomical features; for instance, the compressed form of the wing bones, the elongated sternum, and the very long and obliquely placed ribs, have been modified in the same direction, so as to resemble the corresponding parts of auks and guillemots, though these analogies do not indicate any nearer relationship; of course, the opposite view being only founded upon a complete misconception of their whole structure. Compared with other Tubinares, we note that the end of the nasal tubes, on top of the bill, is cut off

obliquely, so that the nostrils open upwards, a feature evidently produced by the diving habit, in order to prevent water from being forced into the 'nose,' as this tube, with great propriety, may be called. The total absence even of a rudiment of a hind toe is notable, and so is the absence of an *ambiens* muscle, and of the *accessory femoro-caudal*, and *accessory semitendinosus*. It is, in short, a group quite generalized, as is evident from many of its anatomical features, though highly specialized in all that is affected by its diving habits. The group is very restricted in forms, and its geographical distribution is tropical and antarctic. Rev. A. E. Eaton, from whom we have quoted above in another connection, writes of *Pelecanoides urinatrix*, the common diving petrel, which he observed at Kerguelen Island, as follows: "This bird, as Professor Wyville Thomson well observes, has a close general likeness to *Alle alle*. Both of them have a hurried flight; both of them, while flying, dive into the sea without any interruption in the action of their wings, and also emerge from beneath the surface flying, and they both of them swim with the tail rather deep in the water. But this resemblance does not extend to other particulars of their habits. The rothe, when breeding, usually flies and fishes in small flocks of six or a dozen birds, and builds in communities of considerable size, which are excessively noisy. Diving petrels, on the other hand, are more domestic in their mode of living, fishing and flying for the most part in pairs or alone, and building sporadically.—They had begun to pair when we reached Kerguelen Island. The first egg was found on the 31st of October. Their burrows are about as small in diameter as the holes of bank martins (*Clivicola riparia*) or kingfishers (*Alcedo ispida*). They are made in dry banks and slopes, where the ground is easily penetrable, and terminate in an enlarged chamber on whose floor the egg is deposited. Some of the burrows are branched, but the branches are without terminal enlargements, and do not appear to be put to any use by the birds. Before the egg is laid, both of the parents may be found in the nest-chamber, and may often be heard moaning in the daytime: but when the females begin to sit, their call is seldom heard, excepting at night, when the male in his flight to and from the hole, and his mate on her nest, make a considerable noise. There seems to be a difference of a semi-tone between the moans of the two sexes. The call resembles the syllable 'oo' pronounced with the mouth closed, while a slurred chromatic ascent is being made from E to C in the tenor."

ORDER VII. — GRALLÆ.

The order Grallæ, as here defined, is still a rather heterogeneous assemblage, though formerly in a much worse condition, for the Grallæ of olden times comprised, besides those here admitted, the whole order Herodii, and the super-families, Anhimoidæ and Phœnicoptroidæ. It would, perhaps, be an improvement to remove the first two super-families of the present order, viz., Chionoidæ and Scolopacoideæ, to the foregoing order, retaining the name Grallæ for the remaining forms only, and we may expect to see the step taken some day.

As it is, the members of the present order may, in general, be distinguished from those of the foregoing one by the absence of full webs between the anterior toes. True, we have a few 'waders,' with entirely palmate feet, viz., the avocets, but the enormous length of their legs, and the long and thin bill, make them separable from any and all of the Cœcomorphæ at first sight. They are all schizognathous, most of

them with the vomer pointed in front, have two carotids and aftershaft; they all possess the *ambiens* muscle, as also the *semitendinosus*, and the accessory slip of the latter.

Generally, the 'waders' may be said to be littoral in their habits, only few of them being exclusively terrestrial, avoiding the water as carefully as most of them do the open ocean; the shores of the sea and the lakes, the banks of the rivers, and the swamps and marshes are inhabited by some form of this polymorphic group, the members of which are distributed all over the globe, from the icy neighborhood of the poles to the hottest regions under the equatorial sun.

One of the most interesting of all the many interesting and puzzling forms of this order are the birds which compose the super-family CHIONOIDEÆ. The early systematists realized the isolated position of the sheath-bills, and gave the group set aside for them various names, as *Vaginati*, *Coleoramphi*, etc., the curiously constructed bill being the most obvious character. But in regard to the relative taxonomic rank of the group, opinions have differed widely, as it has been referred to every possible grade from a mere genus to an order. Equally variable have been the opinions of ornithologists as to their relationship, since some have referred them to the Gallinaceous birds, others to the Longipennes near the gulls, others again to the *Grallæ*. The former based their conclusions chiefly upon the most external characters and the alleged gallinaceous habits of the birds, the latter took chiefly the internal anatomy into consideration. And, indeed, it seems as if both those advocating their place near the gulls, and those urging their affinity to the plovers and oyster-catchers, are right, for the sheath-bills are so intermediate between them that it is difficult to say where they should rather go, though the present writer is inclined to place them with the latter. In fact they are hardly well placed before both *Laroideæ* and *Charadrioidææ* are united with the *Chionoideæ* in the same order.



FIG. 39.—Lower surface of skull of *Attagus grayi*.

Notwithstanding the external difference between the members of the two families composing this super-family, their mutual relationship has been understood for a considerable length of time, chiefly, we think, on the authority of Bonaparte, who as early as 1832 united them in one family. Of characters which both *Chionidæ* and *Thinocoridæ* have in common, it may be mentioned that they are schizorhinal, that they lack occipital foramina and basipterygoid processes, but have supra-orbital impressions, that the *ambiens* muscle, as well as the femoro-caudal, with the accessory, and the *semitendinosus*, with its accessory slip are present (ABXY+), that they have two carotids, etc. The most remarkable internal feature is, perhaps, the shape of the vomer, which is broad and rounded in front, while in other allied forms, *Cecomorpha* and *Charadriomorpha*, that bone is pointed or bifid anteriorly. The palate, indeed, in this and some other respects, shows some resemblance to that of the *Passerine* birds, this being especially the case with the *Thinocorine* palate, in which the vomer is connected with the nasal cartilages in a manner recalling that of the *Ægithognathæ*.

Like many, not to say most, of those perplexing forms which represent the earlier offshoots, or remain as the last survivors of groups once numerous but long since decimated, the CHIONIDÆ, only two species, inhabit islands in the vast oceans of the

southern hemisphere, they being chiefly found on the islands adjacent to the southern extremity of South America, — Kerguelen's Island and the Crozets.

The most remarkable and quite unique structure of these birds is the saddle-shaped horny sheath, overlying the base of the culmen and partly concealing the nostrils, — hence the name sheath-bill. This sheath is continued backward into a kind of hood covering the face, being naked and carunculated on the lores and ocular region, but densely feathered on the forehead, as represented in the accompanying cut. The bill and the naked skin are yellowish in *Chionis alba*, black in *Ch. minor*, the latter also differing considerably in the shape of the sheath. On the carpus is a knob-shaped prominence which supports a wing spur. The plumage of both species is dazzlingly white all over. The feet are covered with a reticulate skin, both in front and behind; four toes are present, having the normal number of phalanges, which diminish in size from the basal to the terminal one, only very small webs connecting the anterior toes at the base.

The habits of *Ch. minor*, which inhabits Kerguelen's Island and the Crozets, — unless the bird of the latter, which seems to have darker legs, is a separable form, — have been only very recently investigated, and specimens are still very rare in collections. The recent American, English, and German Transit-of-Venus expeditions to that desolate shore have furnished us with excellent descriptions of the manners and peculiarities of that species. All observers agree as to their resemblance in appearance, manner of caressing one another, gait and flight, to pigeons or ptarmigans. Dr. Kidder saw them eat only soft, green seaweed when in the wild state, but Mr. Eaton, of the English party, asserts that they also feed on mussels and isopod Crustacea, and that they greedily devour shags' and penguins' eggs. The former observer enlarges upon their great tameness and curiosity. They nest in holes between or behind rocks, laying one to three eggs, which somewhat resemble those of the oyster-catcher, toward the end of December and the beginning of January. The chicks are covered with a uniform slate-gray down. Males and females are alike, but the loreal caruncle is smaller in the latter, which also has the carpal spine smaller and flesh-colored, and not black as has the male. The young birds are like the adults, but have pink tips to their wings.

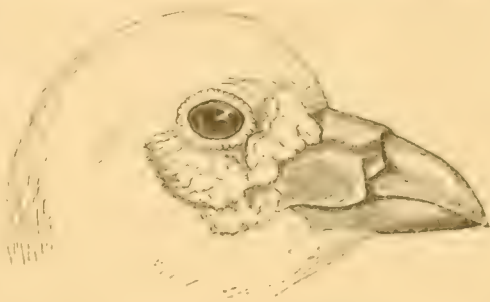


FIG. 40. — Head of *Chionis alba*, white sheath-bill.

The THINOCORIDÆ, a family consisting of two genera, *Thinocorus* and *Attagis*, with together a little more than half a dozen species, inhabit South America down to Magelhaen's Strait and the Falkland Islands; in the tropical portions they occur, however, only in the elevated regions. Externally they resemble, in size and color, quails or partridges, the analogy being carried so far as to also embrace the shortness of the legs, but the long and pointed wings, with the long secondaries, at once suggest their affinity with the Scolopacoid birds. At first they were regarded as Gallinaceous birds, while some authors referred them to the pigeons or sand-grouse; but the Limicoline pterylosis and the many obvious structural characters soon secured place for them among the Grallæ. Finally, Professor Garrod, in 1874, settled the question beyond dispute, by giving an account of all their anatomical characteristics. From his inves-

tigations it is clear that they have strong affinities to *Glareola* and other Charadroid Grallæ. In fact, they incline toward the latter as does *Chionis* toward the gulls. The most noteworthy peculiarity of their structure is the formation of the palate, which is of a "spuriously ægithognathous nature," on account of the broad, anteriorly rounded vomer, and the manner in which the nasal cartilages are there connected, as originally shown by Professor Parker.

The habits of the *Thinocoridae* are very little known, and what we know consists chiefly of what Darwin and—nearly forty years after—Mr. Durnford have ascertained and published concerning the 'gachita,' as *Thinocorus rumicivorus* is called in Buenos Ayres, according to Mr. Hudson. The former says: "This very singular bird, which in its habits and appearance partakes of the character both of a wader and one of the Gallinaceous order, is found wherever there are sterile plains, or open, dry pasture land, in southern South America. Upon being approached they lie close, and then are very difficult to be distinguished from the ground. When feeding they walk rather slowly, with their legs wide apart. They dust themselves in roads and sandy places." He goes on, showing that in all these respects of habit and external appearance the bird resembles a quail. "But," he continues, "directly the bird is seen flying, one's opinion is changed; the long, pointed wings, so different from those in the gallinaceous order, the high, irregular flight, and plaintive cry uttered at the moment of rising, recall the idea of a snipe. The sportsmen of the 'Beagle' unanimously called it the 'short-billed snipe.'" Mr. Durnford ascertained that they breed in Patagonia and visit Buenos Ayres in winter [May to September], sometimes in large flocks. He lays especial stress upon this similarity in habits to the quails and sand-pipers. "When disturbed," he says, "they fly round, uttering a low whistle, and invariably alight head to wind. They remind me of flocks of *Calidris arenaria* (the sanderling) as they stand motionless on the ground." During his journey in central Patagonia (1877-78), he was able to discover its breeding habits, of which he gives the following account: "I took eggs at the end of October; and the young were running in the middle of November: but this species probably has two or more broods in the season; for I found chicks in March. The nest is a slight depression in the ground, sometimes lined with a few blades of grass; and before leaving it the old bird covers up the eggs with little pieces of stick. The eggs are pale stone ground-color, very thickly speckled with light and dark chocolate markings. The chick is finely mottled all over with light and dark brown."

As far as species and individuals are concerned, the super-family now following, the *SCOLOPACOIDEÆ*, makes up the bulk of the present order. The group is a rather well circumscribed one, though a few forms are still in dispute, since some authors, following Huxley and Forbes, are inclined to exclude the bustards and thick-knees as being holorhinal. The question is one of the many in systematic ornithology which cannot be settled at present, and the most judicious course is, probably, to establish a separate super-family for the bustards, equivalent to those of the snipes and the cranes. As the arrangement now is, the characters defining the groups are hardly absolutely trenchant, but may be said in general to be the presence of narrow and prominent basipterygoid processes and the slender and abruptly recurved process of the angle of the mandible in the *Scolopacoideæ*. They are all schizorhinal, except the *Otididæ* and *Œdienemidæ*. The myological formula of the schizorhinal forms is ABXY or AXY; that of the holorhinal members, ABXY or BXY. The bill is elongated and comparatively slender. The ratio of the phalanges of the toes is normal, that is, they diminish

in length from the basal phalange to the penultimate one. The pterylosis has no characteristic features. This super-family is equivalent to the 'order' Limicolæ, as usually adopted, and the 'group' Charadriomorphæ of Huxley.

The first family to meet us is that of the pratincoles or GLAREOLIDÆ, a small group of Old World birds of very peculiar appearance. They have long pointed wings and a rather long, deeply forked tail, a feature quite unique among Limicoline birds. To this is added a rather compressed bill and deeply split mouth, besides comparatively short feet. On the whole they have a very great resemblance to some of the smaller terns both in flight and habits. Nothing is more certain, however, than



FIG. 41. — *Glareola pratincola*, common pratincole.

that these birds are closely allied to the plovers, as also to members of the foregoing super-family, especially the *Chionis*, with which they agree in lacking occipital foramina and basipterygoid processes. That Linnæus placed the common pratincole (*Glareola pratincola*) in his genus *Hirundo*, on account of its forked tail and deeply split mouth, is perhaps not so strange. But that Sundevall, as late as 1874, denied the Charadriine affinities entirely, giving it place in the 'family' Caprimulginae as an aberrant group of goat-suckers, referring, as he did, to the large size of the eyes, the form of the bill, the pectination of the long middle claw, and the somewhat sideways position of the hind toe, shows how unsafe it is to rely upon external characters alone in cases of intricate relationship. The species represented in the accom-

panying cut, Fig. 41, is the common pratincole, which is a regular summer visitor to the Mediterranean sub-region and the valley of the lower Danube, sometimes straggling northwards as far as Denmark and the British Islands. The color above is a fine mouse-gray, the breast is similarly only somewhat lighter colored, shading backward into buff and white; chin and throat of a rusty yellowish buff circumscribed by a narrow velvety black band, which is set off by a white border; the under wing-coverts



FIG. 42. — *Eudromias morinellus*, dotterel, and *Charadrius aprivarius*, golden-plover.

and axillaries are beautiful chestnut; the bill is black, brilliant vermilion at base; feet reddish black. Size that of a small tern. The pratincole, says Mr. Seebohm, who made the acquaintance of this bird in the valley of Danube, in Greece, and Asia Minor, is an inhabitant of sandy plains, large marshes, and bare elevated country, spending a considerable portion of its time in the air, hawking for insects like a gigantic swallow, skimming along with graceful motion, wheeling and darting about, chasing its prey in all directions. Upon the ground it is equally at its ease, and runs

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to and fro with surprising swiftness, in spite of its short legs. The flight is described as swallow-like, or rather like that of the terns. The note, according to Seeböhm, is a peculiar rattle, impossible to express on paper, though the principal sound may be represented by *kr* rapidly repeated. Naumann mentions a peculiar movement of this bird, which he says is exactly like the dipping of the body and jerking of the tail of the wheat-ear (*Saxicola œnanthe*). The food of the pratincole consists exclusively of insects, and an allied species (*G. melanoptera*), differing in having black under wing-coverts, which occurs from southeastern Russia southwards as far as the Cape Colony, is highly estimated as a valuable destroyer of the grasshoppers, according to the interesting account given by the Austrian traveler, Mr. Holub.



FIG. 43. — *Arenaria interpres*, turnstone.

A small family, DROMADIDÆ, with a single living representative (*Dromas ardeola*), may find a proper resting place here after having been knocked around between the herons and the terns. The aspect is that of a plover, or rather a thick-knee with a somewhat large and peculiar bill, and Temminck guessed pretty near the truth when he referred it to the neighborhood of the latter, for the Dutch zoologist, J. van der Hoeven, has shown that the skeleton is very much like that of the oyster-catcher, next to which we place it with the remark that it differs from the true Charadriidæ in having no occipital foramina and no basipterygoid processes, in these respects agreeing with the foregoing families. The 'crab-plover' inhabits shores from India, westward

to Africa, and southward to the Seychelles and Madagascar. Its habits remind us both of the plover and the terns, and so do the unusually large eggs.

The family CHARADRIIDÆ, comprising the Plovers, forms a central and important group of the present order, pretty well circumscribed and homogeneous, though a number of outlying genera present rather trenchant characters, thereby tempting the systematist to establish groups of family rank for their reception. - I refer to the coursers, the turnstones and the oyster-catchers, of which only the latter group has caused me some doubt. The turnstones (*Arenaria*) are somewhat peculiar, having a bill of a type different from the common plover bill, and present in the muscular formula of the leg, an unusual specialization, it being *AXY* against *ABXY* in the

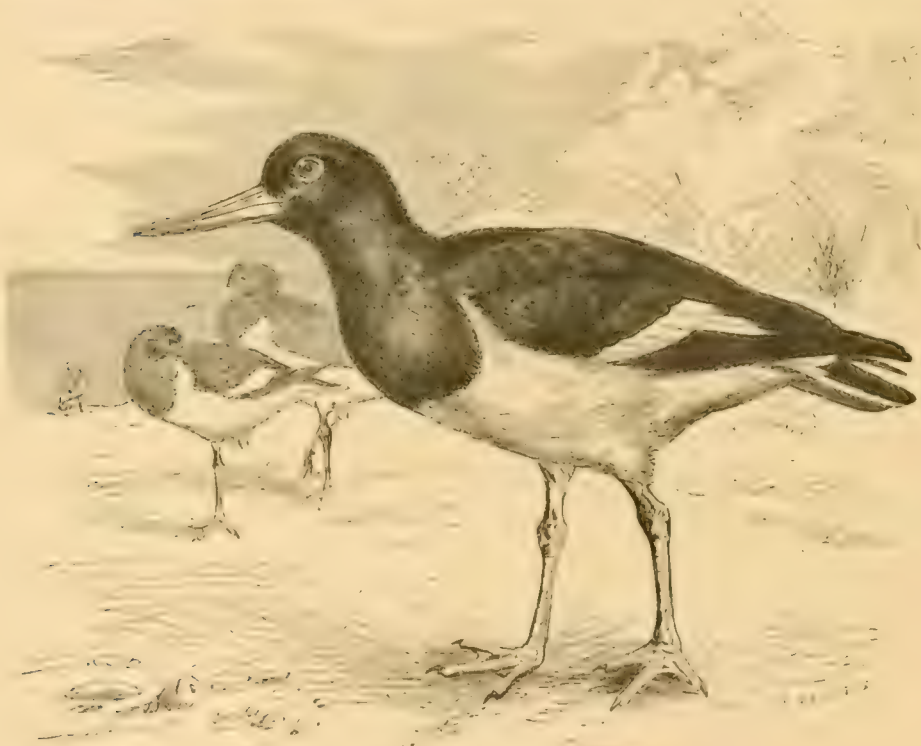


FIG. 44. — *Hamatopus ostralegus*, oyster-catcher.

rest. But the disappearance of the accessory femoro-caudal muscle cannot set off the fact that the genus *Aphriza*, the affinities of which in both directions are manifest, links the turnstones close to the plovers proper. The oyster-catchers (*Hamatopus*) are more isolated, having a peculiarly wedge-shaped bill and large supra-orbital depressions for the glands, but can hardly claim family rank, related as they are to the turnstones. The latter form a genus consisting of only two species, the blackheaded one (*Arenaria melanocephalus*), blackish and white, and exclusively Pacific, besides the common species (*A. interpres*), which is nearly cosmopolitan in its distribution, and distinguished from the former by having rusty-brown margins to the feathers of the back and wings; the feet are a beautiful vermillion red, and the bird is well represented in

the accompanying cut. Together with *Pluvianellus sociabilis*, from Magelhaen's Strait, and the surf-bird (*Aphriza virgata*), found on our western coast up to Alaska, they constitute the sub-family Arenariine. The Hamatopodine consists of a single genus, the different forms of which are distributed over nearly all the shores of the globe, except the very Arctic regions. There are two styles of them, — one black and white, like the European oyster-catcher on the foregoing page, and another wholly black, both with intensely red beaks and reddish flesh-colored feet. They are



FIG. 45. — *Vanellus vanellus*, peewit, lapwing.

very noisy and shy, and make themselves disagreeably conspicuous to the shore-hunter, warning all other birds with their penetrating cry.

The Charadriinæ proper are cosmopolitan in their distribution, embracing the different kinds of plovers, being the most numerous group of the family, and are particularly characterized by the form of the bill, which is somewhat like that of a pigeon, convex anteriorly and restricted at base. Being well-known birds we shall save space for more unusual forms by only referring to the drawings (Fig. 42), and by quoting the following, from Seebohm, concerning the peewit or lapwing (*Vanellus vanellus*, Fig. 45), which is a strictly Palearctic bird, sometimes straggling to Greenland and Alaska. "The flight of this bird is very erratic and peculiar. Its wings are very

long and broad, and it flaps them in a regular, sedate manner. Now it soars upwards for a few yards, seemingly without effort, then flapping its broad and rounded wings it wheels round and round; then it darts rapidly down as if hurling itself to the ground, and then, mounting the air again, with easy grace flies in everchanging course, darting, wheeling, trembling, and reeling, as though beating time with its pinions to its wailing and expressive cries. The lapwing becomes particularly clamorous at night, and obtains much of its food in the dusk of the evening. At all hours its wild expressive call may be heard, as it floats on ever-moving pinions above its favorite haunts. Its common note resembles the syllables *pee-weet*, or *weet-a-weet*, *pee-weet-weet*, from which is derived one of its best known names. The eggs of the lapwing are highly prized as articles of food, and a regular and extensive trade is done in them. Thousands find their way to the London markets in the season, and fetch from four to

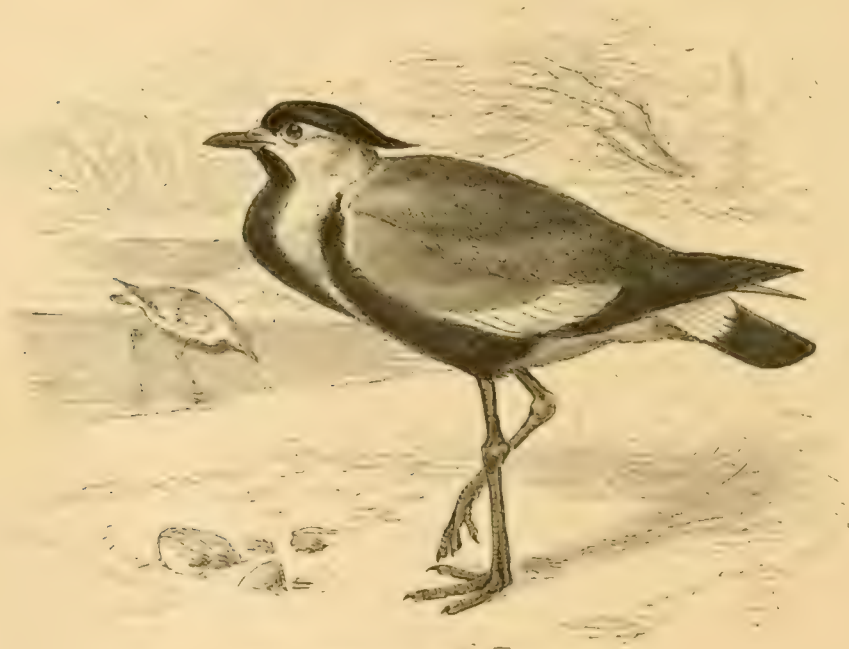


FIG. 46. — *Hoplopterus spinosus*, spur-winged plover.

ten shillings a dozen." This bird is one of the few waders that show metallic colors in their plumage, the general color of the upper parts being a greenish to coppery bronze.

Remarkable for the strong and sharp spur at the bend of the wing is the so-called spur-winged plover (*Hoplopterus spinosus*), hairbrown, black and white, a native of Africa, where it is one of the commonest birds of the Nile valley, but it occurs also in southeastern Europe and the intermediate countries of western Asia. It claims the distinction of being the 'leech-eater' or 'trochilos' of Herodotus, whose description, which is as follows, may rather belong to the black-headed plover, or, as it is frequently called, 'the crocodile bird' (*Pluvianus aegyptius*), also a native of Egypt. "As the crocodile lives chiefly on the river, it has the inside of its mouth constantly covered with leeches; hence it happens that, while all other birds and

beasts avoid it, with the *trochilos* it lives at peace, since it owes much to that bird, for the crocodile, when he leaves the water, and comes out upon the land, is in the habit of lying with his mouth wide open, facing the western breeze; and such times the *trochilos* goes into his mouth and devours the leeches. This benefits the crocodile, who is pleased, and takes care not to hurt the *trochilos*." There is, however, some truth in the old fable, for Alfred E. Brehm, who, during his travels in northeastern Africa, studied the habits of these birds, asserts that he several times saw this plover without hesitation running up and down the back of the crocodile, as if it were a green lawn, in search of bugs and leeches, even daring to pick the teeth of its tremendous friend, that is, literally to snatch away food particles which stuck between the teeth, or parasitic animals which had attached themselves to the mandibles and the gums.

Related to the last-mentioned bird, but on longer legs with shorter toes, a bill somewhat resembling that of the pratincole, and of an isabel color corresponding to the sand of the desert it inhabits, is the cream-colored courser (*Cursorius cursor*), found throughout the southern portion of the Mediterranean province, but known as a not uncommon straggler to the British Islands during the autumnal season. It lives on the arid sand-plains or on the bare elevated plateaus, where scarcely a tuft of scanty herbage or a bush is to be found. It loves to frequent the bases of sand-hills, and is sometimes seen in the miserable desert pastures or amongst the sand-dunes on the outskirts of the oasis. In these dismal uninteresting regions the courser trips about in pairs, or less frequently in little parties."

Completely unique in the shape of the bill, and probably forming a small group of its own, is the so-called wry-billed, or crook-billed plover (*Anarhynchus frontalis*), since the end of the bill is not bent down, nor recurved, but turned horizontally to the right, as shown in the accompanying cut. It was discovered in New Zealand by the French naturalists, Quoy and Gaimard, who, in 1833, published the first description of this curious bird. The type in the Paris museum remained unique until 1869, and the *Anarhynchus* became so apocryphal and dubious that G. R. Gray finally declared the alleged crook-bill to be an individual deformity, an opinion shared by many ornithologists of that day. Nevertheless, the strange crookedness proved to be the normal shape of the bill, the deflexion being obvious even in the chick in the egg. The singular beak is thus described by Mr. Potts from a fresh specimen:—



FIG. 47. — Bill of the crook-billed plover, from above, natural size.

"Bill longer than the head, pointed, curved to the right or off side, curled slightly on itself in a leaf-like manner, a long groove on each side of the upper mandible; the nostrils long, pierced not far from the base of the bill, fitted with a membranous process, which, apparently furnished with a system of nerves, extends some distance along the mandible; interior of both upper and lower mandibles concave or sulcate, which form is maintained to the point; thus the inside of the bill, when the mandibles are closed, becomes a curved pipe, with a very slight twist. The tongue, when at rest, lies well within the lower mandible; it is partly sulcate in form, tapers to a fine point, is much shorter than the beak, leaving a vacant space of six lines from its extremity to the end of the lower mandible; the base is furnished on either side with a few spines (three or four), planted in the same direction as those in the roof of the upper mandible; the thick portion of the tongue is indented with four or five very slight longitudinal furrows, terminating in the channel into which the tongue now resolves itself, till it ends at the very acute point; this sulcate form is attained by the

edges being raised. From this peculiar form of tongue it may be observed that no hindrance is presented by that organ to the sucking up of water; the spines would prevent the escape of the most slippery or minute prey, which could be crushed by the closing of the beak and the pressure of the tongue against the upper mandible, the water finding ready egress."

The same gentleman, after having remarked that this bird is of frequent occurrence near the streams or back waters of almost any of the rivers, which in their course disclose sandy spots and wide areas of shingle, continues thus: "A consideration of the natural features of its favorite haunts permits us to indulge in surmises as to the convenience and adaptation of its remarkable form of beak for obtaining its food. Where we have seen this bird it has never been far from water; and if, as I presume, the species is peculiar to this country (New Zealand), I can point to our larger river-beds as affording it desirable feeding grounds. These rapid shallow streams are perpetually wandering and shifting in their course, cutting new channels after every freshet, whether occasioned by heavy rainfalls or by the melting of snow from the alpine crests of the 'back country.' Any one acquainted with our 'plains' must have observed, here and there, how certain parts (termed by the geologists 'fans') are thickly covered with stones, as, for instance, some miles below the gorges of the Rakaia and Rangitata. However unpromising or useless they may appear to the inexperienced, the practical grazier is aware that these stones assist in keeping the ground cool, and in retaining beneath them a certain amount of moisture, which during the drier portion of the year (when the parching northwest winds prevail) thus invigorates the thirsty rootlets of many valuable grasses, and the result is the maintenance of a fair number of sheep on this rather barren-looking stretch of country. When any of these stones are disturbed from their bed, who can have failed to notice the commotion produced amongst the insect community thus suddenly disclosed to view? What scuttling ensues to gain fresh concealment from the garish light of day! In a somewhat similar manner, after a stream has deserted its temporary bed, numerous forms of aquatic insect life, attracted, in all probability, by the moisture, are to be found in the sand in which the shingle lies half embedded. The horny point of the bill of this bird, from its peculiar form, is sufficiently strong to be used for thrusting between and under stones and pebbles. The flexibility of the upper mandible, derived from the long grooves and flattened form (extending to nearly half its length), tends materially to assist the bird in fitting its curved bill close to a stone, and thus aids in searching or fossicking around or beneath the shingle for its food, while at the same time the closed mandibles would form a tube through which water and insects could be drawn up, as water is sucked up by a syringe. As the flexure of the bill is lateral, the bird is enabled to follow up retreating insects, by making the circuit of a water-worn stone, with far greater ease than if it had been furnished with the straight beak of the plover, or the long flexible scoop of the avocet. The inspection of these specimens must clear away any little cloud of doubt that might remain on the minds of persons unfamiliar with the bird, and convince them that this singular form of bill, so far from being an accidental deformity, is a beautiful provision of nature, which confers on a plover-like bird the advantage of being able to secure a share of its food from sources whence it would be otherwise unattainable." Concomitant with the laterally deflected beak, is a curious asymmetry in the coloration of the plumage, which has been pointed out by Dr. Buller in the following interesting account:—"As already explained, the curvature in the bill is congenital, being equally present in the

embryo chick, although not so fully developed, and this fact furnishes a beautiful illustration of the law of adaptation and design that prevails throughout the whole animal kingdom. A bird endowed with a straight bill, or with an upcurved or decurved one, would be less fitted for the peculiar mode of hunting by which the *Anarhynchus* obtains its living, as must be at once apparent to any one who has watched this bird running rapidly round the boulders that lie on the surface of the ground, and inserting its scoop sidewise at every step, in order to collect the insects and their larvæ that find concealment there. But there is another feature in the natural history of this species that is deserving of special notice. As already described, the fully adult bird is adorned with a black pectoral band, which, in the male, measures .75 of an inch in its widest part. Now it is a very curious circumstance that this band is far more conspicuous on the right-hand side, where, owing to the bird's peculiar habit of feeding, there is less necessity for concealment by means of protective coloring. This character is constant in all the specimens that I have examined, although in a variable degree; the black band being generally about one third narrower, and of a less decided color on the left side of the breast, from which we may, I think, reasonably infer that the law of natural selection has operated to lessen the coloring on the side of the bird more exposed to hawks and other enemies whilst the *Anarhynchus* is hunting for its daily food. There can be no doubt that a protective advantage of this sort, however slight in itself, would have an appreciable effect on the survival of the fittest, and that, allowing sufficient time for this modification of character to develop itself, the species would at length, under certain conditions of existence, lose the black band altogether on the left-hand side."

It is now generally conceded that E. Blyth was right when asserting that the JACANIDÆ are closely allied to the plovers, and that they consequently do not belong to the Rallidæ, or rails, as has been nearly universally thought until recently. In their general aspect, the long toes, and the nearly incumbent hind toe, the jacanas present great analogy to the rails, but the internal anatomy, the knowledge of which is mainly due to Garrod and Forbes, conclusively proves that they belong to the present superfamily. Forbes remarks that, perhaps, no very definite conclusion as to their affinities could be drawn from a consideration of the pterylographic, visceral, and myological features only, but that their osteological characters leave no doubt as to their real position. All the skulls of Jacanidæ examined by him are strongly schizorhinal, therein differing completely from those of the rails, and resembling the plovers and their allies. There are well-developed basipterygoid processes, which are always absent in the rails, though occurring in all the Charadriidæ and Scolopacidæ which he examined. The vomer is emarginate apically, while in the Rallidæ it is sharp at the point. From the Scolopacidæ and Charadriidæ the skull differs chiefly in lacking occipital foramina and supra-orbital impressions. The sternum is quite unlike that of the Rallidæ. In the latter group the sternum is always peculiar, in that the xiphoid processes exceed in length the body of the sternum, which tapers to a point posteriorly, and from which they are separated by very long and well-marked triangular notches. The keel is also less well-developed, and the clavicles are weaker and straighter, being less convex forward, than in the Jacanidæ. The pelvis of the latter is also essentially plover-like, the ilia being wider and more expanded anteriorly, the postacetabular ridge having hardly any median projection, and the pelvis being widest dorsally, just behind the antetrochanters; in these and other points differing from the rails. The toes are enormously elongated and so are the claws. Another external

character distinguishing the jaganas from the plovers and snipes is the number of rectrices, said to be ten in the former, against twelve or more in the latter.

All the forms belonging to this very distinct family have a metacarpal 'spur,' which in the genera *Jacana* and *Hydrophasianus* is large and sharp, while in the others it is small and blunt. Of this spur Professor Forbes remarks, that it has no relation whatever to the claw or nail of the pollex, which is also present, though small. The spur in *Jacana spinosa* at least "consists of an external, translucent, yellow epidermic layer, which invests a central core of compact fibrous tissue, this in turn being supported by a bony projection developed at the radial side of the first metacarpal." This spur is a formidable weapon, but it seems that the forms in which it is small and blunt have received a compensation for the absence of a real spur in an extraordinary development of the radius. In birds, as a rule, this bone is slenderer than the ulna, but in the members of the genus *Metopidius*, and probably also in *Hydractor cristatus*, the radius is dilated and flattened into a sub-triangular lamellar-like expansion for its distal half, as shown in the accompanying cut. The margin of the bone, where it is superficial, is slightly roughened; and no doubt, as Forbes

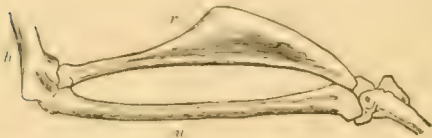


FIG. 48.—Cubitus of *Metopidius*; h, humerus; r, radius; u, ulna.

remarks, the peculiar form of radius is associated with the quarrelsome habits of these birds, this dilated and somewhat scimeter-shaped bone being probably capable of inflicting a very severe downward blow.

The jaganas form a small family of tropical birds, one genus, *Jacana* (or *Parra*, as

it erroneously has been called by most ornithologists), of about four species, being tropical American, with one representative, *J. gymnostoma*, a native of Central America and Mexico, just entering the United States on the border of Texas; while the one figured is the commonest South American species; another genus, *Metopidius*, is Indo-African in its distribution, and *Hydractor* is Malayan, while *Hydrophasianus chirurgus*, hails from India and the countries to the east, including the Philippine Islands and Formosa. The latter, which is the pheasant-tailed javana of writers, is a remarkably striking bird. It is devoid of the naked lobes on the head, so characteristic of the true jaganas, but is especially noticeable for the four enormously elongated tail-feathers, which are gracefully arched like those of a pheasant. The length of the bird is about eighteen inches, the tail alone measuring ten inches. On the authority of Blyth we introduce the following notice of their habits: "These birds breed during the rains, in flooded spots, where the lotus is plentiful, the pair forming a rude, flat nest of grass and weeds, interwoven beneath with the long shoots of some growing, aquatic plant, which retain it buoyant on the surface. Herein are laid six or seven olive-brown, pear-shaped eggs, of an inch and a quarter in length. Their slender bodies and widely extending toes enable jaganas to run with facility, apparently on the water, but in reality, wherever any floating leaves or green herbage meets their light tread. The food consists of the green, tender paddy, or other vegetable growth, dependent on inundation for its production, and the numerous species of insects that abound in such spots. The cry is like that of a kitten in distress, whence their native name of *meowah*. In flight, the legs are trailed behind like those of the herons. The flesh is excellent." Blyth adds that he has sometimes seen it to all appearance walking on the water, the supports on which its long toes really rested being slight and little visible. Legge says that in Ceylon it is wonderfully numerous on the northern

tanks in the "Wanny" district, their musical notes resounding all day and all night long through the picturesque forests on their borders. These sounds are essentially typical of the wild regions in the northern forests of this island, and must always associate themselves in the mind of the naturalist with his wanderings in Ceylon.

The snipes, sandpipers, curlews, etc., form another and still larger family than the plovers, being known as the SCOLORACIDÆ, a group of considerable homogeneity, and chiefly characterized by the long, thin, and flexible bill, which is covered by a soft skin, at the end richly provided with nerves that make the bill a very sensitive probe



FIG. 49. — *Jacana spinosa*, jaçana.

fit to detect in the soft mud and extricate the worms and animalcules upon which they feed. Otherwise they agree pretty much with the Charadriidæ, having a similar pterylosis, and similar muscular and intestinal arrangements. Like those they possess occipital foramina, basipterygoid processes and supra-orbital impressions.

Distributed all over the world, from the icy regions of the north pole to the equator, the snipe tribe populates the sea-shores, the river-banks, the swamps and marshes, while a few only—as, for instance, the woodcock—prefer the drier woodlands to moister localities near the water.

We mentioned above that the present family resembles the Charadriidæ as to the muscular arrangement, but we should have qualified the statement in regard to the muscles of the legs by saying that the myological formula is reversed in the two families, that is to say, that while in the plovers ABXY is the rule, and AXY the exception, so is among the snipes the latter combination the usual one, while only few have all four muscles. Noticeable among the snipes having this more generalized muscular arrangement are the curlews, a small group, the external characters of which are alone sufficient to warrant us in assigning them a somewhat separate position; for the Numeniinæ are characterized by a very long and strongly decurved bill, and by having the tarsus entirely reticulate, or scutellate only for the lower half of the front.



FIG. 50. — *Numenius arquatus*, curlew.

As an additional character may be quoted their comparatively short tongue. The tarsus is totally reticulate in the Asiatic genus, *Ibidorhyncha*, in which, besides, the hind toe is absent, thus to a certain degree justifying the saying that it is a snipe with the bill of an ibis and the feet of a plover. Of this very remarkable form only one species, the red-billed curlew (*I. struthersii*), is known. It was originally obtained in the Himmalehs, but recent explorations in central Asia have shown that it inhabits sandy river banks from Pekin in the east to Turkestan, or perhaps the Kirghis steppes in the west. Its coloration is entirely different from that of the curlews of the genus *Numenius*, which are of a more or less rusty gray with dusky spots all over, while in *Ibidorhyncha* the back is olive colored, the under side pure white, with the top of

head, face, and throat black, as is also a band across the breast; bill and feet vivid red. The arctogæan genus (*Numenius*), consists of four-toed curlews, the migratory habits, extreme shyness, and culinary excellency of which are well known to the sportsman. They range in size from that of the domestic fowl to that of the woodcock. Five species are enumerated as belonging to North America, among these the curious *N. tahitensis*, in which the shafts of the thigh-feathers are prolonged into thin and long, glossy bristles. It inhabits especially the Pacific islands, and has been taken twice in Alaska as an accidental straggler.

In the following sub-family, the *Recurvirostrinae*, the length of bill and feet, especially that of the latter, is carried to an extreme, but, unlike the curlews, the bill is either straight or bent upwards, and in both cases very much pointed. Those with straight bills are called stilts; those with the beak recurved, avocets. The tarsus is covered in front by reticulate scales. They are tropical or subtropical in their distribution. The species are not numerous and are referable to three genera, the distinguishing characters of which Mr. Seebohm has tabulated in the following ingenuous and laconic way:

Feet webbed	{	<i>Recurvirostra</i> ,	} Hind toe absent.
		<i>Cladorhynchus</i> ,	
		<i>Himantopus</i> ,	

He might as well have said "Bill not recurved" instead of "Hind toe absent," however.

This table confronts us with one of the peculiarities of some of the forms, their fully palmate feet being unique among limicoline birds. *Cladorhynchus* is confined to Australia, the two other genera occur both in the Old and the New World, and in the latter both in North and in South America.

A still smaller sub-family comprises the three species of *Phalaropes*, small, rather short-billed, and short-legged birds, with the tip of the bill pointed and the toes furnished with a lateral membrane, which is more or less lobate. The *Phalaropodinae* are more oceanic during their migrations than most birds of this sub-family, and swim with grace and ease. They are arctic and circumpolar in their distribution, wandering far southward in winter.

The central group of the *Scolopaciidae* is formed by an assemblage of birds, of mostly plain grayish or brownish plumage, spotted with dusky, and more or less white underneath, among which are the sanderlings, the godwits, tattlers, sandpipers, the knot, the dotterel, and many other familiar birds. We call this assemblage *Tringinae*, assigning to them as characters the absence of those features which have been pointed out as peculiar to the foregoing groups, adding that they differ from the following sub-family—the true snipes—in having the eyes placed normally. On the whole, the structure of the members is very normal, excessive developments and specializations in any direction being unusual. In this respect the curious spoon-billed sandpiper (*Euryporhynchus pygmaeus*) is a noteworthy exception. The end of its bill is greatly depressed and flattened out, so as to form a broad spade much more disproportionate than the similar formation of the spoon-bill or the shoveller. This bird, which is about the size of the dunlin, and normally sandpiper-colored, is very limited in its distribution and correspondingly rare in collections. It seems to breed somewhere in the neighborhood of Bering Strait, whence most of the specimens have been obtained, traveling south in fall, and wintering on the shores of the Indian Ocean. The habits of the sandpipers are, on the whole, not greatly diversified, although, of

course, each species has peculiarities of its own. They need, however, not detain us here, with the exception of one feature which does not seem to be generally known, viz., that some of the species during the breeding season are capable of producing a real song, which is considerably superior to that of many a "song-bird" proper. Says Mr. Seebohm, for instance, of *Actodromus temminckii*: "I first made the acquaintance of Temminck's stint at Tromsø, on the west coast of Finmark, where it was very common. These charming little birds were in full song in the middle of June. It was a most interesting sight to watch them flying up into the air, wheeling round and round, singing almost as vigorously and nearly as melodiously as a sky-lark. Sometimes they were to be seen perched on a rail or a post, or even on the slender branch of a willow, vibrating their little wings like a wood-wren, and trilling with all their might; and often the song was uttered on the ground as they ran along the short grass with wings elevated over the back. The song of this bird is not unlike that of the grasshopper warbler, but is louder and shriller." Of *Totanus glaucola*, the wood-sandpiper of the Old World, the same author says: "The note which the male utters during the pairing season is much more of a song than that of the grasshopper warbler, which it somewhat resembles; it is a monotonous *til-il-il*, begun somewhat low and slow, as the bird is descending in the air with fluttering upraised wings, becoming louder and more rapid, and reaching its climax as the bird alights on the ground or on a rail, or sometimes on the bare branch of a willow, the points of its trembling wings almost meeting over its head when its feet find support. This song is a by no means unmusical trill, and has an almost metallic ring about it."

Concerning another species, the pectoral sandpiper (*Actodromus maculatus*), Mr. E. W. Nelson made some very interesting notes during his explorations in Alaska, to the effect that the male, during the breeding season, can fill its œsophagus with air to such an extent that the breast and throat are inflated to twice or more the natural size, the great air-sac thus formed giving a peculiar resonant quality to the note which he describes as deep and hollow, but at the same time liquid and musical. The skin of the throat and breast becomes very flabby and loose, so as to hang down "in a pendulous flap or fold, exactly like a dewlap, about an inch and a half wide," even when not inflated. "The male may frequently be seen running along the ground close to the female, its enormous sac inflated, and its head drawn back, and the bill pointing directly forwards; or, filled with spring-time vigor, the bird flits with slow but energetic wing-strokes close along the ground, its head raised high over the shoulders, and the tail hanging almost directly down. As it thus flies, it utters a succession of the booming notes adverted to above, which have a strange ventriloquial quality. At times the male rises twenty or thirty yards in the air, and, inflating its throat, glides down to the ground with its sac hanging below; again he crosses back and forth in front of the female, puffing out his breast, and bowing from side to side, running here and there as if intoxicated with passion. Whenever he pursues his love-making, his rather low but far-reaching note swells and dies in musical cadence, and forms a striking part of the great bird chorus at that season in the north."

When speaking above of the uniformity in structure and habits of the birds composing this sub-family, a mental reservation was made in regard to the ruff (*Paroncella pugnax*). The male, during the breeding season, has the face covered with naked yellowish tubercles, and an enormous ruff of erectile feathers appears simultaneously on the neck. The colors of this ruff especially, as well as of the body, are so diversified that hardly two individuals can be found precisely alike, though it is said that

these infinite variations may be reduced to thirty-three typical ones, the remainder being to all appearance intermediate forms or crosses. The accompanying cut gives only an inadequate idea of its peculiar aspect at this season, but will serve as an illustration for the following account, the excellency of which may be an excuse for again introducing Mr. Seebohm: "There are two points of special interest attaching to the history of the ruff, which are probably intimately connected with each other. One of them is the extraordinary variety of the plumage of the males in the breeding season, and the other is the fact that the ruff is polygamous. It is said that the females largely outnumber the males. Naumann estimates the proportion as three to one, and this discrepancy is confirmed by African collectors. The males contend in



FIG. 51. — *Paroncella pugnax*, ruff.

single combat for the right of being 'cock of the walk,' and for this purpose battle-fields are chosen, like the 'laking-places' of the capercaillie and the blackcock. These are sometimes on a slight elevation, but usually are nothing more than a spot of open ground in the marsh, where a patch of level short grass is to be found, four or five feet across, and so situated that it may be exposed to the view of the admiring females. The same piece of ground is chosen year after year, and Naumann mentions an instance of one which had been thus used for half a century. Frequently two or three duels are going on at once on the ground, but they seldom last long. After what looks like furious sparring, the weaker cock retires from the 'hill,' seldom any worse for the fray, and the conqueror awaits another foe. These cock-fights are not commenced until the ruff or collar is fully grown, which is seldom before the middle

of May, and are discontinued as soon as the feathers on the neck begin to fall out, which happens about six weeks later. Soon after sunrise is the best time to observe them, but I have watched them in Russia and in Holland as late as eleven in the forenoon. The excitement of the birds is intense; they stoop with their heads low, and their ruffs expanded, and fly at each other like game-cocks, but, unlike those birds, they fight with the bill and not with the foot. The warts on the side of the face of the ruff only remain during the spring, and, doubtless, serve as a protection against the sword-thrusts of their adversaries."

The Scolopaciæ are birds of the twilight, and, like all birds of similar habits, are structurally adapted to their peculiar manners of life. Thus, the plumage is soft, and the coloration has that curiously mottled character which we will find in the owls and goat-suckers. The eyes are large and full, but in order to give them place in the little snipe-head without diminishing the ears, which also are of great importance to nocturnal birds, the eyes have been pushed so far behind in the skull as to be situated just above the ear-openings. The bill is very long, flexible, and covered with a soft skin, richly supplied with nerves. The tarsus, like that of the Tringinae, is scutellate both in front and behind. The snipes proper, including the so-called woodcocks, are cosmopolitan in their distribution, and of migratory habits in cold climates, the many different species being of a bewildering similarity. A curious feature of these birds is, that a number of species present strangely modified tail-feathers, the number of which is often enormously increased over the normal, for instance, *Gallinago stenura*, from eastern Asia. This abnormality of the tail-feathers in many forms has been taken as an argument in favor of the theory that the bleating sound of the common snipe (*Gallinago gallinago*), is produced by aid of the rectrices. Others have contended that the wing-feathers are the instrument by which it imitates so closely the goat, and bitter discussions have been carried on between eminent ornithologists for more than twenty years. Together with several distinguished observers, I hold that the sound usually emanates from the throat, but that its bleating quality is produced by the vibration of the wings when the bird descends from its height. We quote the following from our own experience:—

"Very often the snipe would rise so high in the air as to become almost invisible to the unaided eye, but still the strange sound rang vigorously down to the observer. Not only this power of the sound, but even more so the nature of the tune itself, convinced me that it originates from the throat, and not in any way either from the tail or the wing feathers, as suggested by many European writers. It is true that the wings are in a state of very rapid vibration during the oblique descent when the note is uttered, but this circumstance does not testify only in favor of the theory of the sound being produced by the wing, as the vibration most conclusively accounts for the quivering throat-sound. Anybody stretching his arms out as if flying, and moving them rapidly up and down, and simultaneously uttering any sound, is bound to 'bleat.'"

This group includes a small, strongly-defined genus which we designate by its oldest name as *Rostratula*, more commonly known as *Rhynchota*. The geographical distribution is somewhat remarkable, a representative species being found in each of the following provinces: Africa and Madagascar, India and south-eastern Asia, Australia and southern South America. It will be observed that this peculiar distribution is similar to that of many isolated forms; for instance, the Jacanidæ, Heliornithidæ, Trogonidæ, *Dendrocygna*, *Plotus*, etc., affording a valuable hint as to the origin and past distribution of these more or less 'aberrant' forms. *Rostratula* has other peculi-

arities, however, not the least interesting being the fact that the secondary sexual characters are completely reversed, the female being considerably larger and more brilliantly colored than the male. In addition to this the females "deputize the duty of incubation to the other sex, and reserve the business of courting to themselves." Still more remarkable is that, in the female of *R. bengalensis*, the windpipe is more or less tortuous, forming a distinct loop lying between the integument and the inter-clavicular membrane on the left side," while in the male it is straight and simple; for, as Darwin says, whenever "the trachea differs in structure in the two sexes it is more developed and complex in the male than in the female." The arrangement is even more extraordinary in the female of the Australian species (*R. australis*), in which, according to



FIG. 52. — *Rostratula capensis*, painted-snipé.

Gould, the trachea passes down between the skin and the muscles of the breast for the whole length of the body, making four distinct convolutions before entering the lungs. The painted-snipé, as the species is called, is well represented in the accompanying cut. The predominating color is olivaceous, with buff and black markings, underneath olivaceous, brown, and white. Blyth states that the Asiatic species, when surprised, has the habit of spreading out its wings and tail, and so forming a sort of radiated disk which shows off its spotted markings, menacing the while with a hissing sound and contracted neck, and then suddenly darting off.

While all the foregoing families of the Charadroid types are schizorhinal, the two following ones are distinguished as being holorhinal. On account of this arrangement of the nostrils they have by some systematists been removed from this superfamily

and placed near the rails, but the total sum of characters seems to demand that the bustards and thick-knees be left with the *Limicolæ*, as a kind of connecting link between these and the rails and cranes.

The *ÆDICNEMIDÆ*—in English called thick-knees, stone-curlews, or, better, stone-plovers—have the general aspect of large plovers, with a rather long bill, the gonydeal angle of which is strongly pronounced. The wings are pointed, the tarsi are reticulated, and the hind toe absent. The number of forms composing this family is small. Their distribution is inter-tropical on both hemispheres, and no species belongs to the fauna of North America, while a single species, *Ædicnemus ædicnemus*, extends its range into southern and central Europe, including England. Like its congeners it



FIG. 53. — *Ædicnemus ædicnemus*, stone-plover, thick-knee.

frequents the lowland heaths and bare lands where it has an unobstructed view all round. Its habits are to a great extent nocturnal, and it is particularly at nightfall and on moonlight nights that its clamorous voice is heard when out in search for food, which consists of insects, snails, etc.

Mr. C. C. Nutting, who collected in Nicaragua, gives the following account of the Central American species, *Æ. bistriatus*: "This curious bird is gregarious, and lives in the pastures surrounding the hacienda, where it makes itself useful by eating the various insects that annoy and injure the cattle. On this account it is protected by the inhabitants of the country, and it was only as a particular favor that I could persuade 'Don Alejandro' to allow me to shoot a couple of specimens. The bird is exactly like a gigantic plover in appearance and motions, and is frequently seen in a

state of domestication in the little flower-gardens which occupy the inner courts of the houses of the aristocracy, and here it works for its living by keeping the garden clear of insects, worms, reptiles, etc."

The Indian and Australian genus, *Esacus*, is characterized by its much larger bill. Its coloring is gray above, whitish beneath, with no spots. In size it is considerably larger than the stone-plovers, and equal to that of the smaller bustards.

The OTIDIDÆ, or bustards, compose the second holorhinal family, forming a well-circumscribed group, externally characterized by the short, somewhat vaulted bill without prominent chin angle, the long and stout legs finely reticulated anteriorly and behind. The toes are very short and stout, their number only three, and Forbes failed in discovering even a trace of the hind toe underneath the skin. In their general aspect these birds closely resemble the gallinaceous type, which in their habits they also recall to a certain extent. Some of the species are very large, the size ranging from that of a turkey to that of a willow-ptarmigan, being generally very stoutly built. Notwithstanding this apparent clumsiness the bustards fly well, and run with amazing swiftness, which once caused them to be included with the Ostriches in an "order" called *Cursores*. They are, consequently, especially adapted to the open country, and are, in fact, "the birds of the steppes *par excellence*." Their food is chiefly vegetable, thus differing widely from most of the members of the present order. It is strange that, notwithstanding the fact of some of the species occurring and breeding in central Europe, the question whether these birds are polygamous, as has been asserted, or not, cannot be said to be finally settled yet, though the negative evidence seems to be the stronger. The family belongs exclusively to the Old World, no form being found in America. The centre of distribution of its about thirty-five species may be said to be Africa, but many species occur in central and southern Asia, and two are regular inhabitants of the temperate lowlands of Europe. Also Australia has its representation, but it is a significant fact that bustards are absent in Madagascar and the Malay Islands. Of structural peculiarities in this group may be mentioned that several species have a gular pouch with an opening underneath the tongue. This pouch is capable of being inflated. It is especially well developed in the great bustard of Europe (*Otis tarda*), and much speculation as to its use has been indulged in. Some thought it a water-reservoir, while others, from the fact that sometimes a few seeds or some trifling quantity of grass have been found in it, believed that it was used as a receptacle for food. There is no doubt any longer, however, that the presence of this sac during the breeding season is simply a secondary sexual character, and that it is only a temporary air-chamber, to be inflated and distended during the "showing off." Not less interesting is the fact that the pouch is absent in many species, and that a simple distension of the œsophagus in some results in the neck swelling and depending in a similar manner. Another anatomical peculiarity is that members of the genus *Eupodotis* have only one carotid artery, — the right one, — while in other birds with only one carotid it is the left that is present.

Many of the species are adorned with strutting bristles, ruffs, or feather-tufts. One of the smallest species is the one figured, the little bustard (*O. tetras*), of common occurrence in southern Europe, and not larger than a grouse. Another species which also occurs in Europe, though only as an accidental straggler, is the western Asiatic houbara (*Houbara macqueenii*). How this bird, which is intermediate in size between the great and the little bustards, is chased by the aid of the camel, may be of interest to the sportsman, and the following is therefore borrowed from Hume's

"Game Birds of India." "It is weary work trudging on foot, under an Indian sun, after birds that run as these can and will, and in the districts where they are plentiful, people always either hawk them or shoot them from camels. Taking the camel at a long, easy, six miles an hour trot across one of those vast wildernesses they affect, you will not be long before—raised high up as you are on camel-back—you catch sight of one or more houbara feeding amongst the bushes. To them camels have no evil import; everybody uses them; none but the veriest pauper walks, every one rides,



FIG. 54. — *Otis tetrax*, little bustard.

and rides camels. When, therefore, the houbara see you coming along on a camel, they only move a little aside, so as to be out of your line of march, and you at once begin to describe a large spiral round them, so that, while appearing always to be passing away from them, you are really always closing in on them. Sometimes, if the time be early or late, or if the day be cold or cloudy, long before you are within shot, they start off running, and, if you press them further, ultimately take wing, flying heavily, and soon resalighting and running on, never, so far as I have seen, taking the

long flights that the great bustard does, and never fluttering and skylarking in the air as do the little ones. Generally, however, if the time be between ten and four, and the day bright and warm, as your spiral diminishes, the birds disappear suddenly. They have squatted. Still you go on round and round, closing in, in each lap, and straining your eyes, usually in vain, to discover their whereabouts; suddenly, perhaps from under the very feet of the camel, up flutters one of the birds, and, after a few strides, rises, to fall dead a few yards further on, as they are easy to hit and easy to kill. At the first shot all the houbara that are at all close usually rise; but after shooting a brace right and left, and having them picked up and slung, I have known a third to blunder up from within a few yards. The way they will squat at times on an absolutely bare patch of sand is astonishing; their plumage harmonizes perfectly with the soil, and you will have a bird rise suddenly, apparently out of the earth, within five yards of you, from a spot where there is not a blade of cover, and on which your eyes have perhaps been fixed for some seconds. This is especially the case about mid-day, when the sun is nearly vertical, and no shadow is thrown by the squatting bird. Sometimes they try another plan: they get behind a single bush, and as you circle round they do the same, always keeping the bush between themselves and the sportsman. Here, unless the sun be quite vertical, their shadow projected on the ground, apart from that of the bush, is sure, at certain positions in the circle, to betray them, and a shot through the bush brings them to bag."

Like most of the erratic and isolated types of birds, the members constituting the super-family EURYPYGOIDEÆ have been hunted round the ornithological system from order to order, until, of late, anatomical researches have proved their mutual relationship and their remoteness from the forms with which they were more or less commonly associated. As long as external characters alone were relied upon, the sun-bitterns were considered rails by some, herons by others; while the curious *Mesites* was in turn one of the Passeres and a Gallinaceous bird. When the anatomists finally decided their relationship and united with them the kagu, placing them all near the Scolopacoid birds, more nearly related *inter se* than to any other group, the verdict had to be, and to a great extent has been, accepted by ornithologists at large.

In the first place these birds are schizorhinal, and furthermore they lack occipital foramina, basipterygoid processes, and supraorbital impressions. To these important characters of the skull, besides important ones from other parts of the body,—for instance, the comparatively low insertion of the hind toe,—may be added the presence of powder-down patches among the feathers, a feature elsewhere only met with in the herons, some parrots, goatsuckers, hawks, and a few others.

Three families compose the super-family, each of which are represented by a single genus only, the genera again being nearly monotypical. The sun-bitterns are South American, *Rhynochetos* is from the island of New Caledonia in the Polynesian Archipelago, and *Mesites* is peculiar to Madagascar. This distribution is considerably disconnected, and seems at first glance to oppose the view of the relationship of these birds, but we need only refer to what has been said on a previous page, under *Rostratula*, in order to show that the peculiar geographical distribution of these forms, the antiquity of which cannot be doubted, is rather in favor of the present arrangement, and they can only be regarded as the last survivors of a group which, simultaneously with others of similarly old-fashioned aspect, once populated continents now sunk, or inhabited by forms of a more modern type. Just how the ancestors of the recent *Limicolæ*, on one hand, and the cranes and rails, on the other, branched off

from that common stock of which we here see the more or less direct descendants, will not be ascertained before the embryology of all these forms shall be known, and perhaps not even then. Nor may we expect much from future palæontological discoveries; here and there a find may throw some light upon affinities and the history of development, but the gaps are great and many. We will therefore, for the present at least, have to content ourselves with such reasonable probabilities as can be derived from the comparative anatomy and the geographical distribution.

The sun-bitterns, family EURYPYGIDÆ, genus *Eurypyga*, as already indicated, are South American birds of a rather peculiar appearance, something between a rail and



FIG. 55. — *Eurypyga helias*, sun-bird, sun-bittern.

a heron, though the long tail, the ample, broad wings, and the peculiar coloration at first glance distinguishes them from both. Referring to the cut for further details of external structure and for the general aspect, we need only mention in regard to coloration that the sun-bird, as it is also called, is beautifully variegated with white, brown, and black bands and mottlings, the head being black with white marks. The eye is red, bill and feet yellow. The feathers are soft, and the shafts of those on the back and rump are extremely fine and delicate in the centre, which causes the tips of each feather to turn the reverse way directly the bird is dead. Another remarkable feature is the extremely thin neck. The sun-bitterns inhabit the banks of the great

rivers and are said to be very shy. Nevertheless, they are easily tamed, and travelers assert that they are often kept in captivity by the natives inhabiting the valleys of the Amazon and Orinoco. They are therefore often found in the zoological gardens, where they thrive very well. They bred first in the London Zoological Garden, and from the account by the superintendent, Mr. A. D. Bartlett, we select the following concerning this event: "Early in the month of May, 1865, they began to show signs of breeding, by carrying bits of sticks, roots of grass, and other materials about; they were constantly walking round the pond, evidently in search of materials to compose a nest, and appeared to try and mix wet dirt with bits of moss, etc. This suggested the idea of supplying them with wet clay and mud, which they at once commenced to use. After a short time they settled to make a nest on the top of a pole or tree about ten feet from the ground, on which was fixed an old straw nest. One egg was laid, but broken, but early in June another was found, resembling that of a woodcock rather than any other bird. The two birds were very attentive, and took turns at incubation, and in twenty-seven days the young bird was hatched. It is certainly one of the prettiest young birds I ever saw. It is thickly covered with fine short tufts of down, and much resembles the young of the plovers and the snipes, with the addition that the head and body was thickly covered with rather longer hairs than are to be seen in the former-mentioned birds. The young bird remained in the nest and was fed regularly by both parents, the food consisting principally of small live fish, a few insects, etc. The mode of taking its food was somewhat peculiar: it did not gape and call or utter any cry like most nestlings; but as soon as the old birds flew upon the nest with the food in their bills, the young one snapped or pecked it from them and swallowed it at once. The young bird remained in the nest twenty-one days, by which time its wings were sufficiently grown to enable it to fly to the ground. It was then fed as before, and never afterward returned to the nest; it grew quickly, and at the end of two months was indistinguishable from the old birds. Early in August the old birds began to repair the nest, and added a fresh lining of mud and clay, and at the end of August laid another egg. In remarking upon these interesting facts, I may observe that the egg differs considerably from the eggs of any true Ardeine bird with which I am acquainted, in its spotted and blotched markings, and in this character bears a strong resemblance to those of the plovers and snipes; nor are these the only resemblances, its downy covering, color, and markings leading one to regard it as allied to these forms."

Kagu is the native name of a remarkable bird, which is only known from the island of New Caledonia, forming a separate genus, *Rhynochetos*, the type of an entire 'family,' RHYNOCHETIDÆ. Bartlett had already, from external characters, insisted upon the relationship of this form with the sun-bittern, when Professor Parker, from an osteological point of view, asserted that *R. jubatus* and the sun-bittern are very closely allied, and that these are allied again to the cranes, rails, herons, and plovers, though more generalized than any of these, regarding them, in fact, with *Psophia*, of which more later on under the cranes, as indicating the way by which these different types have developed. We shall not go into details here concerning the anatomical features of the kagu, referring as we do to the accompanying cut representing the skeleton, but we wish to call attention to the weakness of the sternal girdle, the breast-bone corresponding nearly to the embryonic stage of that bone in the crane, and to the great height and steepness of the iliac crests of the pelvis, and the peculiar bend downwards at the hinder part of the sacrum. A noteworthy difference between the

intestinal arrangement of the kagu and that of the sun-bitterns is that in the latter the cæca are nearly rudimentary, while well developed in the former. As to external characters it will suffice to mention the long pending nape crest, and the peculiar scroll-like membrane overhanging the openings of the nostrils, the use of which, according to Dr. Murie, seems to be to close the openings when the bird, as is its habit, digs into the soft soil for its food, thus preventing foreign matters from entering the



FIG. 56.—Skeleton of *Rhynochetos jubatus*.

nostrils. The manner of closing these lids he describes as follows: "As the nostril approaches the ground and is touched, its anterior part, having a plough-share formation or scroll-like contour, sends the earth upwards over it. The springy, semi-elastic lid, from in front to behind, is pressed down and inwards, finally completely closing the aperture as the beak is thrust deep into the earth in search of its living prey." I may add that the nostrils of *Eurypyga* are simple, without any closing membrane.

During their stay on New Caledonia, Messrs. Layards, father and son, made interesting studies into the history of this singular bird, the color of which is gray, lighter beneath, and with cross marks of brown, black, and gray on the wing- and tail-feathers, recalling a similar style of coloration in *Eurypyga*, while the iris is orange, and feet and bill orange-scarlet. From their account we make the following extract:—

"In former times it seems to have been generally distributed all over the island, but it has now nearly disappeared from the neighborhood of the more settled and inhabited parts. It is usually caught by the natives with dogs, among rocks and stones in precipitous ravines in the mountains. In habit it is strictly nocturnal, lying concealed and asleep during the day in its rocky retreats; but as soon as night comes, and especially in wet weather or during heavy dews, the 'kagou,' as it is called by the natives, sallies forth in search of worms, slugs, snails, and such like, on which it feeds. It runs with great rapidity, but has the habit of remaining during the day in one position for a considerable length of time, like the herons. Swainson would have undoubtedly made this bird a link between them and the rails.

"All our endeavors to procure the eggs of this bird or reliable information on its nidification have proved futile or contradictory. The majority of the natives have

never even seen an egg, which some say is blue, others brown and speckled; and none can answer the question as to whether the young birds are, or are not, able to run from the moment of their being excluded. We have kept these birds for some time in confinement, feeding them on the large *Bulini* (which can be purchased in the market, whither they are brought as an article of diet for our French colons), raw meat, etc. They are noisy at night, uttering a guttural rattling note, and their antics of an evening have sometimes reminded us of the African *Scopus umbretta*."

The kagu has been kept in captivity. The superintendent of the London Zoological Garden thus describes some of its peculiarities: "With its crest erect and wings spread out, the kagu runs or skips about, sometimes pursuing and driving before him all the birds that are confined with him in the same aviary, and evidently enjoying the fun of seeing them frightened. At other times he will seize the end of his wing or tail, and run round, holding it in his bill. From a piece of paper or dry leaf he derives much amusement, by tossing it about and running after it. During his frolic he will thrust his bill into the ground and spread out his wings, kick his legs into the air, and then tumble about as if in a fit."

From Madagascar, the wonder-land where once the Epiornis roamed about, hails the third member of this puzzling group, not the least puzzle of the three types composing it. In addition to its strange structure, the rarity of the alleged two species in the museums, the types being unique for many years, made it the more difficult for ornithologists to find out the truth about it. *Mesites*, the only constituent of the family MESITIDÆ, was therefore by some referred to the Gallinaceous birds, by others to the pigeons, and still in 1872 Sundevall insisted upon the bird being oscinine, only with the larger wing-coverts abnormal, and the tibiae naked at the lower end, "like the waders." The anatomical investigations of A. Milne-Edwards finally enabled the systematists to settle the question as to its relationships. He himself referred it to the rails, but Garrod and Forbes have pointed out the schizorhinal character of *Mesites* as compared with the holorhinal rails, and the position with *Eurypyga* and *Rhynochetos* was confirmed when Mr. E. Bartlett, son of the gentleman mentioned above, discovered that it has powder-down patches. He first found two very distinct patches on the back of the neck. This naturally led him to search for others, which he also found, viz., one on each side of the lower part of the rump, close to the tail, one on each side of the upper part of the pectoral muscles, a third pair, one on each side, running across the ribs, on to the pectoral muscle, and a fourth pair, one on each side of the abdominal region, running parallel with the vent, making in all five pairs. He also found that the feathers of the back and wings show the same peculiarity as those of *Eurypyga* described above. To complete the characterization of *Mesites*, we may add that the bill is long and slender, like that of the sun-bittern, the nostrils are long and linear, overhung by an elongated cutaneous operculum. The tibiae are naked below, and the tarsus scutellated in front and behind, like the corresponding parts in the other two families. A noteworthy character is also the blue naked space round the eye. The general coloration is cinnamon brown, head and under side more or less marked with black in *M. variegata*. The whole external aspect is admitted by Bartlett to be "very thrush-like."

The super-family CARIAMOIDEÆ we shall introduce with a remark of Professor Newton, to the effect that he "is inclined to think that those who have urged its affinity to the Accipitres, and among them taxonomers starting from bases so opposite as Sundevall and Professor Parker have more nearly hit the mark, and accord-

ingly would now relegate it to that order. It is doubtless an extremely generalized form, the survival of a very ancient type, whence several groups may have sprung; and whenever the secret it has to tell shall be revealed, a considerable step in the phylogeny of birds can scarcely fail to follow." Nevertheless, the seriema is also evidently allied to the cranes, and until the question concerning its relationship to the African secretary-bird be finally settled, we may provisionally keep it where it has been placed by most authors; though we confess the belief that it has passed the dividing line, and should properly be placed with its African cousin among the 'birds



FIG. 57. — *Cariama cristata*, seriema.

of prey,' both forming distinct families of a super-family named as above. The visceral anatomy is shown by Martin and Gadow to be essentially crane-like, corresponding closely with the arrangement found in *Psophia*, the gizzard having one radiating tendinous patch on each side, and the intestines give off two long cæca, characters not shared by the Raptorial birds. The pterylosis, according to Nitzsch, has much that is peculiar about it, but it most closely approaches that of *Psophia* and *Grus*. The oil gland is entirely naked, even on the mamilla. But the osteology, on the other hand, tends toward the Raptores. Not only the sternal apparatus shows an approach in that direction, but especially the palate, which even Huxley himself admits is not

schizorhinal, although not quite typically desmognathous either. He says that in *Cariama* the internasal septum is ossified to a very slight extent, and the maxillo-palatine processes may meet in the middle line, in both of which respects it approaches the birds of prey; but the ossified part of the nasal septum does not unite below with the maxillo-palatines, in this respect being unlike the Raptorial birds.

Two genera, each consisting of one species, are known, viz., *Chunga burmeisteri*, from the Argentine Republic, and *Cariama cristata*, the species figured, from Brazil. An interesting difference between the two closely allied genera is the variation in the myological formula of the legs, the latter being expressed by BXY, while B is absent in *Chunga*. We may add that BXY is the normal formula of the cranes and bustards. Both have a curious crest of frontal plumes, that of the figured species being the longest. The coloration of this species is of a sandy brown above, sandy buff beneath, finely vermiculated with fulvous and blackish, and with a white terminal band on the tail. The orbits are bare and blue, eye yellow, bill cinnabar-red.

The seriema is a large bird, about the size of the great blue heron, and of a very striking appearance, not the least so on account of the curious frontal crest. In some of the Brazilian campos it is common, and its penetrating, though not unpleasant voice, may be heard close to the inhabited places several hours even before sunrise. It is protected by the law, and a fine is imposed upon anybody killing the bird, which is thought to destroy a good many snakes. Prof. Reinhardt, however, denies this, and says that he only found insects and seeds in the stomach. The chungas, as the other species is called by the Spanish inhabitants of the Argentine Republic, is smaller and more ash-colored, with black bill, and the lores are densely feathered. Dr. Hartlaub, when describing it, gave the following accounts of its habits, from the notes furnished by its discoverer, Prof. Burmeister, after whom it was named:—

“It is found in the wooded districts of the province of Tucuman and Catamarca; it nests on the ground. Its eggs are white, slightly spotted with rufous. It feeds upon insects, and more especially upon locusts. The young have a rufous dress, thickly undulated with black; they very soon begin to take care of themselves. The chungas is easily domesticated, and seems, even after a few days of captivity, attached to its master. In its wild state it is very difficult to kill, therefore it is preferable to search for the nest, and bring up the young birds by hand. The cry of the bird is heard very frequently in the district where it is found, and sounds like the bark of a young dog, but not quite so loud.”

The apparent broad gap between the cranes and rails, which had led many to regard them as separate ‘sub-orders,’ broke down when it was shown that *Aramus*, the limpkin, according to its anatomical characters, belongs to the cranes and not to the rails, where it before had been universally placed. We therefore do not hesitate to unite them in the super-family GRUIOIDEÆ, notwithstanding the holorhinal character of the rails. In this case the latter character does not seem to me to be of a fundamental nature, since if the Ocydrominae, which unquestionably are rails, really are holorhinal, as Garrod asserts, they come as near being schizorhinal as any holorhinal bird can, judging from photographs of the skeleton, of which a reproduction may be found further on (Fig. 60, p. 128). This super-family corresponds with the usually so-called ‘order’ Alektorides, a most unfortunate name, however, since its original inventor made it to include the pratincole, the cercopsis, the seriema, the screamers, and the trumpeter, the last being the only genus belonging to it as it is now

usually defined, while the typical forms were scattered about among "Herodii, Macrodaetyli, and Lobipedes." A better name for the group if regarded as an order is therefore Paludicolæ. It also correspond pretty nearly to Huxley's 'family' Geranomorphæ, which he characterized as having a relatively strong bill, the angle of the mandible truncated, and not produced into a slender and abruptly recurved process; as lacking basipterygoid processes, with only one known exception, and as having a comparatively narrow sternum. To this we may add that the breast-bone is either truncated behind without notches, or it has one pair of notches and the lateral pro-



FIG. 58. — *Psophia crepitans*, trumpeter.

cesses reaching beyond the body of the sternum; the area of the origin of the obturator internus muscle is triangular, and not oval; two well-developed cæca are always present. The pterylosis is not characteristic, and powder-downs are never present. Although some of the members of the super-family extend their breeding range even within the Arctic region, still the great majority are strictly tropical.

Evidently related to the kagu and the seriema, and likewise in their structure exhibiting characters to a certain degree uniting rails and cranes, the South American trumpeter birds, *Psophiidae*, form the first family. The legs are rather high, and the toes short, the hind one small and elevated. The bill is short and vaulted, almost

Gallinaceous in shape, giving the whole head quite a pheasant-like appearance. The plumage of the head and neck is short and velvet-like, this peculiar texture being caused by an upward curvature of the shaft with which is combined a very soft and almost downy structure of the barbs and barbules. The general arrangement of the pterylosis, however, agrees perfectly with that of the cranes proper, and, like the latter, the trumpeters have the oil-gland furnished with a circlet of feathers at the tip. One of the most remarkable osteological features is, according to Parker, that the lacrymal (preorbital) bone is followed by a chain of five to seven free suborbitals, like those of the tinamus. "This cropping-up again of what the tinamus has adopted from the reptile is very interesting, and is not the only character by which these two birds may be connected." The sternum is unnotched, and truncated behind.

Only one genus, *Psophia*, consisting of half a dozen species, is known, among which is *P. crepitans*, the trumpeter. The name trumpeter refers to the loud and very curious ventriloquous sound which these birds produce by closed mouth. Agami or yakamik is the name by which they are known to the Indians. The species mentioned is confined to the countries north of the Amazon, where it was met with by Richard Schomburgh, who gives the following account of its habits: "It is found in the forests all over British Guiana, and may often be seen in flocks of a hundred to two hundred individuals. They do not seem to leave the forests at all. Being unusually easy to tame, they are also found in the settlements of the Indians, ruling with undisputed sovereignty the other poultry as also the tame quadrupeds; even the big hoecoes have to submit to their sway. Their power of flight is so weak that, when the flocks fly across a river of any consequence, several of the birds usually fall into the stream before reaching the opposite bank, in which case they save themselves by swimming. They seem to prefer the moist forests near the coast to those of the interior. Their meat is palatable. They nest on the ground."

The cranes, GRUIDÆ, have a longer, more compressed bill, and a harder plumage, with the tertials usually elongated and drooping, or very broad with open and decomposed vanes, in the latter case capable of being raised at will to form a very striking ornament. Several cranes have a smaller or greater part of the head bare and covered with papillæ. As already remarked, they are schizorhinal, and the hind border of the breast-bone is truncated. The formula of the thigh muscles is ABXY, BXY, or XY. Some—or rather most—of the cranes have a very loud and resounding, trumpeting or whooping voice, the depth and resonance of which is produced by the peculiar convolutions of the windpipe within the hollow keel of the breast-bone. The twistings of the trachea, which enters the keel below, at the junction of the merry-thought, passes along the edge, then turns forwards, and comes to the front underneath the body of the breast-bone, then turns back again, being differently bent and curved in the different species before it finally leaves the hollow and proceeds into the interior of the thorax, act in a similar way as the convolutions of the French hunting-horn. The most extreme development is found in the whooping-crane (*Grus americana*) of this continent, which "has a windpipe between four and five feet long, of which no less than twenty-eight inches are coiled up in the keel of the breast-bone." The length and development of the convolutions increase with the age, and in the young they are altogether absent. With regard to these we quote the following from Mr. T. I. Roberts: "In the embryo crane just about to break the shell, the trachea does not enter the sternum at all, and is perfectly simple. But the anterior part of the keel, which is entirely cartilaginous and diminutive, is much more thickened, and a cross

section of it shows it to consist of two thin walls, separated by a marrow-like substance. In this feature of the sternum we see the only indication in the embryo of the singular structure to be developed later in life. The degree of complexity of the trachea is thus shown to be dependent upon age, and the variations are no doubt fully accounted for by this fact."

The cranes are gregarious, and those inhabiting the northern hemisphere are eminently migratory. During their migrations the flocks travel in V-like array, like those of wild geese. They are mainly vegetable-feeders, and some species are even exceedingly destructive to the grain crop.

The group is one of considerable antiquity, and was formerly richer in forms than nowadays, like the next foregoing and following families. A gigantic species, *Grus*

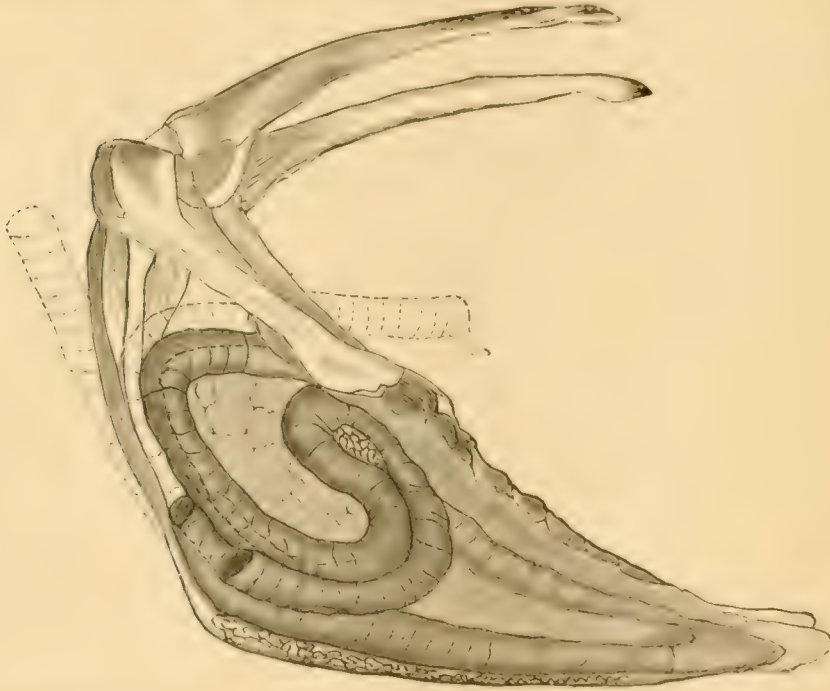


FIG. 53. — Breast-bone and lower part of windpipe of the whooping crane, *Grus americana*. The entire left side of the keel has been cut away to show the interior. About one-half natural size.

primigenia, inhabited France during the 'reindeer period,' and remains of cranes have been traced back to the miocene of Europe and the pliocene of North America. At present the species are few, and their geographical distribution somewhat peculiar. They occur now, during one or another season of the year, everywhere except in South America and the Malayan and Polynesian archipelagoes. One species is peculiar to Australia, two are North American, four are exclusively African, while the rest are chiefly Asiatic; the headquarters of the restricted genus *Grus* being the temperate parts of eastern Asia.

Altogether there are only about seventeen well-defined species, referable to three or four genera. On the full-page plate the three chief forms are represented. In the background are seen a flock of the common European crane (*Grus grus*), yelling at

the approach of the V-shaped flight above. The four birds in the foreground, having the peculiar crest or crown on top of the head, much like that of a peacock, are the northwest African crowned-crane (*Balearica pavonina*); the southern species, *B. chrysopelargus*, having a large, pendulous, naked throat-lappet. In this genus the windpipe is simple and does not enter the keel. The light-colored bird to the left, in front of the others, is a 'demoiselle' or 'Numidian' crane (*Tetrapterix*, or *Antropoides virgo*), of which a better representation will be found on the full-page cut of the *Balaniceps rex*, in the upper right-hand corner (facing p. 172). Like the other cranes, the demoiselle, which occurs from Mongolia in the east to northern Africa in the west, is fond of dancing, as described in the following graphic account of the Russian naturalist, Prof. von Nordmann: "They arrive in the south of Russia about the beginning of March, in flocks of between two and three hundred individuals. Arrived at the end of their journey, the flocks keep together for some time, and even when they have dispersed in couples, they re-assemble every morning and evening, preferring in calm weather to exercise themselves together, and amuse themselves by dancing. For this purpose they choose a convenient place, generally the flat shore of a stream. There they place themselves in a line, or in many rows, and begin their games and extraordinary dances, which are not a little surprising to the spectator, and of which the account would be considered fabulous were it not attested by men worthy of belief. They dance and jump around each other, bowing in a burlesque manner, advancing their necks, raising the feathers of the neck-tufts, and half unfolding the wings. In the meantime another set are disputing, in a race, the prize for swiftness. Arrived at the winning-post they turn back, and walk slowly and with gravity; all the rest of the company saluting them with reiterated cries, inclinations of the head, and other demonstrations, which are reciprocated. After having done this for some time, they all rise in the air, where, slowly sailing, they describe circles, like the swan and other cranes. After some weeks these assemblies cease, and from that time they are seen constantly walking in loving pairs together."

It would not do to leave the cranes without having given the readers a taste of J. Wolley's account of the breeding of the crane in Lapland, which Professor Newton has styled "one of the most pleasing contributions to natural history ever written," and I only regret that want of space prohibits the reproduction of it unabridged. Wolley, in 1853, went to Swedish Lapland in order to find out, among other things, whether the young crane, on first leaving the egg, is helpless like a young heron, or able to run about like the young of most waders and Gallinaceous birds, and to observe the breeding habits for himself. He came after the birds were hatched, but he satisfied himself that the young cranes, after leaving the eggs, could run about. He had to wait a year to get the eggs. Here are his words: "The following year, 1854, on the 20th of May, I went with only Ludwig — my servant-lad — to look for the crane's nest in 'Iso noma' [the great swamp]. We saw no birds, and the spot where the nest had been the preceding year was not easy to find in so extensive a marsh. So we quartered our ground, walking carefully up one strip of harder bog and down the next. After some hours of heavy walking, I saw the eggs — joyful sight — on an adjacent slip, in a perfectly open place. The two eggs lay with their long diameters parallel to one another, and there was just room for a third egg to be placed between them. The nest, about two feet across, was nearly flat, and chiefly of light-colored grass or hay loosely matted together, scarcely more than two inches in depth, and raised only two or three inches from the general level of the swamp. There were

higher sites close by, and many of them would have seemed more eligible. It was just at the lowest edge of the strip, but so much exposed that I thought I should be able to see even the eggs themselves from a spot at a considerable distance, to which I proposed to go. There was a common story amongst the people of the country, that the crane, if its nest were disturbed, would carry off its eggs under its wings to another place, so I purposely handled one of the eggs, and hung up a bit of birch-bark on a birch-tree beyond the nest, as a mark by which to direct my telescope. Then I went with Ludwig to a clump of spruce growing on some dry sandy land, which rose out of the midst of the marsh. Here I made a good ambuscade of spruce boughs, crept into it, got Ludwig to cover me so that even the crane's eye could not distinguish me, and sent him to make a fire to sleep by on the far side of the wood, with strict orders on no account to come near my hiding-place. I kept my glass in the direction of the nest, but it was long before I saw anything stir. In the meantime the marsh was by no means quiet; ruffs were holding something between a European ball and an East Indian nautch. Several times 'peet root, peet root,' to use the words by which the Finns express the sound, told where the snipes were. A cock pintail dashed into a bit of water, calling loud for its mate. The full, melancholy wailing of the black-throated diver came from the river; watch-dogs were barking in the distance; I heard the subdued hacking of wood and the crackling of Ludwig's fire. It was already about midnight; fieldfares were chasing each other through the wood; one came pecking about my feet, and another, settling on the branches that covered my back, almost made my ears ache with the loudness of its cries. I often heard the waft of known wings, but three times there sounded overhead the sweeping wave of great wings, to which my ears were unaccustomed. I could scarcely doubt it was the cranes, but I dare not turn up my eye; I even once or twice heard a slight chuckle that must have been from them. At length, as I had my glass in the direction of the nest, which was three or four hundred yards off, I saw a tall gray figure emerging from amongst the birch-trees, just beyond where I knew the nest must be, and there stood the crane in all the beauty of nature, in the full side light of an Arctic summer night. She came on with her graceful walk, her head up, and she raised it a little higher, and turned her beak sideways and upwards as she passed round the tree on whose trunk I had hung the little roll of bark. I had not anticipated that she would observe so ordinary an object. She probably saw that her eggs were safe, and then she took a beat of twenty or thirty yards in the swamp, pecking, and apparently feeding. At the end of this beat she stood still for a quarter of an hour, sometimes pecking and sometimes motionless, but showing no symptoms of suspicion of my whereabouts, and indeed no manifest sign of fear. At length she turned back and passed her nest a few paces in the opposite direction, but soon came in to it; she arranged with her beak the materials of the nest, or the eggs, or both; she dropped her breast gently forward, and, as soon as it touched, she let the rest of her body sink gradually down. And so she sits, with her neck up and her body full in my sight, sometimes preening her feathers, especially of the neck, sometimes lazily pecking about, and for a long time she sits with her neck curved like a swan's, though principally at its upper part. Now she turns her head backwards, puts her beak under the wing, apparently just in the middle of the ridge of the back, and so she seems fairly to go to sleep. I was now sure the crane would not carry off her eggs. After enjoying for a short time longer this sight — and no epithet is yet in use which expresses the nature of the feelings created by such scenes in the minds of those who

fully enjoy them — I found that the air was freezing. I quickly got up, and on reaching the fire made myself comfortable.”

Aramus was still in 1870, by Gray, associated with the typical rails within the same genus. Here, as in so many other cases, Garrod's investigations of the anatomy exploded an arrangement solely based upon external characters. He, in 1876, demonstrated that the limpkin is schizorhinal, that it has supra-occipital foramina, that the palate, the sternum, and, in fact, the whole skeleton, is completely Graine. He pointed out that the pterylosis exactly agrees with that of *Psophia* and *Grus*, according to Nitzsch, who says that it would have to be placed with these “if in its bill and its long toes it did not so distinctly resemble *Rallus*. The form of the wings and the texture of the plumage are, however, exactly as in *Rallus*. The myological formula is BXY. The cæca are well developed, and peculiar in being situated laterally and close together, instead of opposite one another. Altogether the ARAMIDÆ are completely intermediate between cranes and rails, making their separation into different sub-orders indefensible.

The family of the limpkins or courlans is a very small one, consisting only of one genus of two species, and is strictly Neogæan, or rather tropico-American, in its distribution. One species, *A. pictus*, is restricted to Central America, the West Indies, and southern Florida. The other, *A. scolopaceus*, inhabits eastern South America. Mr. E. Gibson has recently contributed the following notes concerning the habits of the latter, or the ‘vidua loca,’ as the Spaniards call it:—

“The Spanish name — the literal translation of which is ‘mad widow’ — is given to this bird by the natives from its sombre plumage, solitary habits, and peculiar cry. It is generally distributed through the swamps, frequenting the deeper ones by preference, and, though usually found singly, may be met with in fours and fives, or even as many as twenty. Mr. Durnford correctly describes its ‘heavy, laborious flight, performed by slow beats of the wings, which it sometimes raises so high as nearly to meet over its back,’ but might also have added that the legs hang down at an angle of forty-five degrees, giving the bird a particularly ungainly appearance, and that its flight is never prolonged. The cry, more indulged in at night than through the day, is a loud, long, melancholy wail, and, heard towards the small hours, produces an uncomfortable eerie feeling on the hearer. It might be some lost spirit of the swamps, or Nickar the soulless himself, shrieking and crying.”

Since the last family, the RALLIDÆ, or rails, have already been characterized by comparison with groups previously treated of, it is therefore sufficient to mention that they are holorhinal, have no basipterygoid processes, nor supra-occipital foramina, they have all the five classificatory thigh-muscles, long cæca, and tufted oil-glands. The bill is rather short and hard, the toes very long. The affinities of the family have also been mentioned, though it should be added that prominent anatomists have recognized relations towards the Gallinaceous birds. The characters pointing in that direction indicate, perhaps, the generalized nature of the rail type and its antiquity rather than direct affinity.

The rails are particularly interesting, not only for their structure and habits, but also for the fact that the family contains numerous forms which by disuse of their wings have been deprived of the power of flight, and in which, therefore, the structure of the parts constituting and supporting the organs of flight have become greatly modified. The fact that several of these forms have become extinct during historical times directly or indirectly by the action of man adds considerably to the interest.

We divide the family into several groups of lower rank, as true rails, wood-hens, purple gallinules, true gallinules, and coots, the latter being distinguished by their lobated toes, like grebes, the gallinules by the horny shield which covers the forehead.

The true rails are distributed all over the world, being, however, chiefly tropical and especially numerous in America. They are usually more or less sombre-colored birds of very retired, partly crepuscular habits, populating swamps and marshes, and very little known—except by their often loud and harsh voice—to others than those who as sportsmen or naturalists make them a specialty. The Virginia rail (*Rallus virginianus*) and the Sora rail (*Porzana carolina*) are familiar examples from this continent, while the common European corn-crake (*Crex crex*) is only a casual visitor to our eastern coast.

Closely related to the rails proper, but singularly specialized in many respects, are the wood-hens, as they are called by the English colonists in the South Sea. Several species of the genus *Ocydromus* are inhabitants of New Zealand, and have, like many other bird types of the region, lost their power of flight by disuse. They are rather large birds, about the size of the domestic fowl, with stout feet, small and weak wings, and correspondingly feeble development of the shoulder girdle and the breast-bone, the keel being very low, as shown in the accompanying cut of the skeleton. The analogy of the retrograde development of the fore limbs and the parts supporting them in these birds, with the state of the structure in the struthious birds inhabiting the same region, is very instructive as indicating the probable origin of the latter by a similar process of reduction caused by disuse. In this connection there is a point of considerable importance, viz., that in *Ocydro-*



FIG. 60.—Skeleton of *Ocydromus fuscus*.

mus the angle between the scapula and the coracoids is less acute than in flying Carinates, thus approaching the arrangement in the Struthionine bird, and in the equally flightless extinct *Hesperornis*. A further hint in the same direction is the fact that the angle mentioned is equally obtuse in the skeleton of the dodo. Some anatomists go even so far as to suggest a comparatively close relationship between *Ocydromus* and the kiwis, as, for instance, Prof. Garrod, who says "so many features have they in common, that it would be difficult to bring convincing argument against the statement that *Ocy-*

dromus is one of the nearest allies of the *Apteryx*. This similarity may be the simple result of similar influences acting on different natures, the diminished necessity for the use of the anterior limbs allowing them to dwindle in both. But, with the facts of geographical distribution to back it, the opinion may be fairly maintained that *Apteryx* and *Ocydromus* had the same ancestor not far back in time. It may be said that the pelvis is very different; but the same remark partly applies to *Tinamus*, an undoubted ally, and a bird also most probably of the same stock, though residing so far off." With regard to the geographical distribution, we once more refer to our remark under *Rostratula* (p. 110), with the addition that Ocydromine birds can also be traced to the islands of the Mascarene fauna. When the earliest explorers came to these islands, they found the dodo and other large and strange birds which were deprived of the power of flight. These helpless creatures very soon became extinct, by the direct action of man or by the mammals which the first navigators turned loose, or the first settlers brought with them. Only some old pictures, scanty descriptions, and a heap of bones collected by Prof. Newton, are the remains from which we have to construct our knowledge of these remarkable forms. A few of them were brought alive to Europe, where they were figured. Among these are some paintings on vellum of a curious-looking bird, with a long, snipe-like beak and no wings, altogether very much like a kiwi. It is evidently the "poule rouge au bec de Bécasse," from Mauritius, which is said by a Dutch preacher, J. C. Hoffmann, who lived there in 1673-1675, to have been caught in the following manner:—

"A rod is taken in the right hand, and the left is wrapped in a piece of red stuff, which is thus shown to the birds, commonly assembled in numerous flocks. Whether the red color terrifies these stupid birds, or whether it attracts them, they approach the fowler almost without fear; and he, when they are at a convenient distance, strikes and seizes one. The cries which the captive utters attract its companions, who seek to deliver it, and thus all become the prey of the fowler." With this 'poule rouge,' Alphonse Milne-Edwards has identified a number of bones collected in Mauritius by Edward Newton, the examination of which resulted in the following conclusion concerning the affinities of *Aphanapteryx broeckii*, as this bird has been styled: "It evidently was one of the family Rallidæ, and there is much less difference between it and *Ocydromus* than between this last and the [true] rails." Another bird of the same family is the white 'géant,' figured and described by the French colonist, Leguat, who lived on Rodriguez during the last decade of the seventeenth century. *Leguatia gigantea*, which measured six feet in height, with a body as large as a goose, may possibly be a water-hen or gallinule, with frontal shield.

The common wood-hen (*O. australis*), or the weka, as it is called by the Maoris, is as sure one day to become extinct as was Leguat's 'géant.' We read in Buller's History of the Birds of New Zealand that "the weka is too often killed only for mere wantonness, or the pleasure of taking life. The Maoris of Arowhenua make expeditions in the winter for obtaining a supply of these birds, which they preserve in their own fat. On one run, near Burke's Pass, I have been told that over two thousand wekas were secured by a party of natives at one of these hunts. Numbers are also killed by the settlers for their oil, which is much esteemed for dressing saddle-straps and for a variety of purposes."

Of an allied species, *O. sylvestris*, which inhabits Lord Howe's Island, between New Zealand and Australia, we have the following account by Mr. R. D. Fisher:

“When ascending the mountain, the guide stopped suddenly, as a note like the rasp of a saw was heard at some distance among the loose stones and ferns, and exclaimed, ‘That is a wood-hen.’ He then imitated the note of the bird, and the wood-hen replied. He again tried the imitation, but the bird was silent. Another guide accompanying us then struck the back of the tomahawk against a tree; again the bird answered; further strokes of the tomahawk were useless, no reply could be obtained. Then a dog was made to bark, and with effect; the call of the bird was again heard,



FIG. 61. — *Porphyrio porphyrio*, purple-gallinule.

and again and again as often as the sounds were made and varied. At each time it was apparent that the bird was approaching nearer and nearer to our position, until the bird ran out, apparently quite confused and bewildered, close to our feet. The dog seized the bird and killed it, otherwise it might have been captured alive. It appears that the noise made to attract the bird must be constantly varied, one continuous sound having no effect. No wonder that they are becoming scarce, and will, no doubt, be soon extinct.”

The purple-gallinules, as typified by the European species (*Porphyrio porphyrio*) and the American *Ionornis martinica*, are stoutly built birds with a high and strong bill, frontal shield, long toes without lateral membrane, and a beautiful plumage mostly of a brilliant blue color. The long toes enable them to walk readily over the water plants, and "the large foot is frequently employed to hold the food, very much in the manner of a parrot, while the bird is eating."

Precisely the same relation as have the wekas to the true rails is held by *Notornis* and *Aptornis*, the latter entirely extinct, the former only partially so, to the purple gallinules. On account of the peculiarities caused by the reduction of the wings they might be regarded as rather distinct, but recent discoveries and examination of ample material has shown them to be quite Ralline, though *Aptornis*, in its sternal modifications (the breadth of the breast-bone being greatly reduced and the place of the keel only "indicated by a mere low obtuse ridge), has departed further from the existing forms." *Notornis* is entirely extinct on the northern island of New Zealand, but on the southern island three living specimens of the 'moho,' or 'pukeko,' (*N. mantelli*) have been taken within this century up to a very recent date. The last survivors of this doomed bird have been taken in localities nearly a hundred miles apart, and at intervals of twenty-two, and twelve years, so that possibly a few more may still be alive in some secluded spot. The first specimen was taken by seal-fishers in 1847, the third one by a rabbit-hunter in 1881.

A gentle transition to the true gallinules is formed by the so-called *Habroptila wallacii* from the Moluccan island Gilolo, a form with a remarkable lax plumage, and so short and weak wings, that it must be unable to fly, meeting in this respect a true gallinule from the Samoan Islands, which Hartlaub and Finsch have called *Pareudiastes pacificus*. The large eyes indicate nocturnal habits, and Mr. S. J. Whitmee tells that the natives positively assured him that the 'punahe' burrows in the ground and nests in the burrow. It was formerly more common, and is, like all birds deprived of flight, and confined to a restricted locality, doomed to an early extinction. The gallinules proper, as represented by our so-called Florida gallinule (*Gallinula galeata*) and the European moor-hen (*G. chloropus*) form a small group scattered all over the warmer and temperate regions of the globe. A near relative of the last-mentioned species, which lives on the lonely island Tristan d'Acunha in the South Atlantic, and has been described by Dr. Selater as *G. nesiotis* is worth mentioning, since it most conclusively illustrates the effect of isolation by reducing the sternal apparatus and the power of flight, concomitant with increasing the size and the strength of the hind extremities. In the external appearance and coloration the 'island-hen' differs only little from the moor-hen, which may be regarded as the parent stock, but the form is shorter and thicker, and the legs stouter, though the toes are not longer. The wing, however, is shorter, and the feathers remarkably soft and inferior in size. Still more striking are the differences in the skeleton, for in *G. chloropus* the proportion between the size of the breast-bone to that of the pelvis is as $4\frac{1}{2}$ to 4, while in *G. nesiotis* it is as $3\frac{1}{4}$ to 5; in other words, in the former the breast-bone is larger than the pelvis, in the latter the pelvis is larger than the breast-bone. It is therefore easy to understand that the specimen which was brought alive to London could only "flutter a little, but obviously uses its legs and not its wings as a mode of escape from its enemies."

The last and most specialized groups of the Rallidæ consist of the coots, exemplified by our American species, *Fulica americana*, to which is closely related the European coot, *F. atra*. The character which at once distinguishes them from the other

rails is the broad lobes of their toes, giving their feet a strong resemblance to the corresponding organ of the grebes. In consequence they are good swimmers and pass the greater part of their life on the water, breeding near lakes, pools, or quiet rivers, and only during the migrations may they be found at salt water. The group is not more numerous than that of the gallinules, and the different members deviate very little from the typical species, which are of a slaty black, usually with some white marks in the region of the tail, the most remarkable species being, perhaps, the rare South American *Licornis*—with some curious caruncles on the forehead. Like the other members of the family, coots once played a more important rôle than now. Also among the coots we find species, probably deprived of the power of flight, which inhabited the Mascarene Islands, and became extinct through the action of the early colonists. Such a one was the large *Fulica newtonii*.

ORDER VIII.—CHENOMORPHÆ.

It has been necessary to adopt this outlandish name for the ducks and their allies composing the present order, in place of the well-known Anseres or Lamellirostres, since we make it to include two forms which fall outside of the group designated by the two latter names. Following the view of Parker and Huxley in associating the screamers with the ducks, the propriety of which shall be treated of further on, we also adopt the name which Huxley invented.

This order opens the series of desmognathous birds which are characterized by having the palatal bones united across the middle line, either directly or by the intermediation of ossifications in the nasal septum. "The desmognathous skull," to use Huxley's own words, "appears under its simplest form in *Palamedea* [*Anhima*] and the Lamellirostres. In these birds each maxillo-palatine is a broad, flat, and thin bony plate, which unites with its fellow in the middle line of the palate. The septum may be more or less ossified. The basipterygoid processes are represented by oval facets, sessile upon the rostrum, and placed so far forward that the surfaces which articulate with them are situated close to the anterior extremities of the pterygoid bones." In the flamingoes the basipterygoid processes are rudimentary, and the maxillo-palatines are enlarged and spongy, filling the base of the beak. All the members of this order have the angle of the mandible strongly produced and upcurved.

The Chenomorphæ, as here defined, are divisible into three sections, suborders or superfamilies, as we may choose to call them, each well defined and presenting characters of its own. At the present time the gaps between them are rather considerable, and their position relative to other orders is also one of isolation, but the discovery that different though evidently nearly related forms of the Chenomorphæ at present most isolated have been numerous during earlier geological periods indicates that the gaps may eventually be bridged.

The most isolated, and, on the whole, most generalized group is that of the so-called screamers, the superfamily of the ANHIMOIDEÆ. The most different views have been held as to their position in the system, though usually they were referred to the neighborhood of the rails or the 'Alectorides.' Great was, therefore, the amazement when Parker and Huxley first announced the view that the screamers come nearer to the ducks, basing their opinion upon the anatomical structure. Garrod and Forbes, however, not less prominent as ornithotomists, held that *Anhima* and *Chauna* were sufficiently remote from all other orders to form one by themselves alone. We

have here accepted the former view, since it seems to us that the osteology points strongly towards the Lamellirostres, while the characters in which they disagree are mostly of a generalized or 'reptilian' character. The extraordinary interest of this group requires that we shall go a little into details. "All the skull and face, except at its two ends, conforms to the lamellirostral type," says Prof. Parker, "point by point, process by process, lamina for lamina, all else is truly and distinctly that which belongs to the sifter, and to no other bird." It has been remonstrated that the lacrymal region is not long in the screamers, though this peculiarity is very pronounced in the Anseres and flamingos, but the Lamellirostral *Cereopsis* is intermediate in this respect. In the desmognathous character of the palate, in the situation of the articular surfaces for the jugal arches considerably behind the level of their mandibular articulations, and in the configuration of the latter, besides in the prolonged and upcurved angle of the mandible, the screamers are distinctly anserine. As to the breast-bone we again quote Parker: "The sternum of this bird differs from that of the goose or swan by just so much as the sternum of the short-winged rails, especially *Brachypteryx* [= *Oeydonas*], differs from that of the ordinary types. It is narrower behind, and the episternum is gone from the front: yet it is thoroughly anserine in character, for the keel does not reach the end." The pelvis of the spur-winged goose (*Plectropterus*), the same author says, is "exactly intermediate between that of a typical goose and that of a *Palamedea*," and he also points at the fact that the *Plectropterus* has the legs longer, more grallatorial, and better under them than the typical forms. It is also probably more than a coincidence that the screamers have spurs on their wings—not only claws to the fingers—like the goose mentioned. The toes of the screamers are not palmate, but there are true Anseres in which the toes are split nearly as much. Their most extraordinary osteological feature, however, is the absence of uncinate processes to the ribs, unique among living birds, and only shared, so far as we know, by the *Archæopteryx*. The respiratory organs are truly anserine. Garrod himself admits that "in that the lower end of the trachea is of a smaller diameter than is the tube higher up, in that in the same part the constituent rings are in close contact without scarcely any intervening membrane, in that there are two pairs of tracheal muscles running to the thoracic parietes, and in that the intrinsic lateral tracheal muscles end before they reach the bifurcation of the bronchi, the syrinx of the screamers approachesthat of some of the Anseres," but adds, "in that there is no special modification of the organ in the male" they are not Anserine. This may be so in *Chauna*, but Cuvier, in speaking of *Anhima cornuta*, says (according to Dr. Crisp) that "it has a bony box in the middle of the trachea, like that of the velvet pochard (*Oidemia fusca*)," a most conclusive Anserine character. The alimentary canal presents features of great interest. In the great length of the large intestine, already pointed out by Dr. E. Crisp, it agrees only with that of *Struthio* and *Rhea*, and, like these two types only, the cæca are situated a considerable distance from the cloaca. Moreover, the cæca agree with those of the Struthioness mentioned in being sacculated, but they are unique in having a well-developed special sphincter muscle guarding the opening into a special cavity common to both cæca, which again is separated off from the colon proper by a very constricting sphincter. As to the primary myological features it may be remarked that the thigh-formula is ABXY+, while in none of the Anseres proper is the Y present. The latter muscle, however, is of little account to short-legged birds, and seems to be very easily lost, by swimmers especially. We will see, further on, that the flamingo has retained the Y, but lost the A. The pterylosis of the screamers is peculiar, since the

feathers and downs are evenly dispersed over the body, with only an *apterium* in each axillary cavity. This is an extremely generalized character, but as the *Anseres* probably have developed out of an ancestor in which the plumage was equally uninterrupted, it bears only little upon the relationships of the group in question. A peculiarity of the screamers is the extreme pneumaticity, not only of the bones, nearly every one of which is permeated by air, but also of the cutaneous system. As this feature merits attention, we quote Garrod's description nearly in full: "The most striking point observed in the plucked bird is the extreme whiteness of the surface, which depends on the fact that the skin is almost universally emphysematous to the depth of nearly a quarter of an inch. On pressing with the finger, the characteristic crackling of a tissue filled with air is most marked. . . . In the gannet and the pelican the skin is likewise emphysematous, but not exactly in the same way. In them the superficial surface of the cutis forms a plane surface, and the deep layer another, with the air-cells intervening between them, and the feather-quills traversing them. In *Chauna*, however, these two cutaneous layers are not definable, the whole presenting the appearance as if a non-emphysematous skin had been forcibly blown up, so as to cause its surface to be irregular and bubbled, more like an artificially distended mammalian lung than anything else. The feathers and the semi-plumes do not perforate the air-cells, but cause the skin to be indented where they are situated. The disproportionately massive appearance of the legs is also caused by the presence of air beneath the tessellated skin, which extends almost to the ungual phalanges of the toes."

In the bill the *ANHIMIDÆ* differ considerably from the ducks and flamingos. It is short vaulted, and, on the whole, somewhat Gallinaceous in its form, being neither lamelloso-dentate nor covered with a soft skin. Other external characters of importance are the long and disproportionately thick legs, the long toes, the low hind toe, and the long and straight claws.

The habitat of these birds is tropical and temperate South America. The family is a very small one, consisting of only three species belonging to two genera. *Anhima cornuta* (or *Palamedea cornuta*), the species figured, is a most curious and unique looking bird, being a true avian 'unicorn.' From the forehead rises a thin, forward-curved horn, five to six inches long, and, as in the species of the genus *Chauna*, which have no horns, but naked lores and a long, occipital feather-crest, each wing is armed with two strong spines, the larger one at the bend, the other further down on the hand. The horned-screamer does not seem to deserve its name as much as the other two species, for the sound emitted by it is said to be a loud and sudden hoot, very different from the scream of the chahas. They are all said to be tamed and employed by the natives as herders and protectors to the poultry which they defend against birds of prey and other enemies. Mr. E. Gibson has recently given the following account of the habits of the crested-screamer:—

"*C. chavaria* is, as may well be imagined, a most striking bird, both in size and appearance; and when such is the case with one individual, the impression produced by seeing a hundred pairs together is not likely to be less. There is a large island among a network of swamps a mile from here [Cape San Antonio, Buenos Ayres], on which, at certain seasons of the year, I have frequently seen that number, not collected into a flock, but in pairs. The swamps and brackish lagoons constitute its haunts and feeding-grounds. On one or two occasions I have seen a bird alight in the deeper water and swim with only a very small portion of its body immersed; but it prefers to wade where the marsh is shallower. But what most excited my astonishment was

to see a chaha perched on the top of a tree twenty feet from the ground. A week after this occurrence I saw three birds in a similar position, in a small wood on the edge of one of our larger lagoons. During a long residence here, and thorough acquaintance with this species (seeing it every day, in fact), I have never witnessed more than these two cases of such a feat on the part of *C. chavaria*, and should have been utterly sceptical of the testimony of everybody else to the fact. In the summer-time it is much addicted to soaring, and scores may be seen at a time,



FIG. 62. — *Anhima cornuta*, horned-screamer.

rising in great spiral circles till they become mere specks in the sky, and actually disappear at last. Even at this elevation the cry is distinctly audible, and has often drawn my attention to the bird as having really vanished into the blue ether. The cry, which may be often heard at night, is frequently indulged in, and consists of the syllables *cha-ha*, uttered by the male, while the female invariably responds to it, or rather follows it up with *cha-ha-li*, placing the accent on the last syllable. Preparatory to producing it, if on the ground, the bird draws back its head and neck slightly; and

at that moment, if one is sufficiently near, the inhalation of air into the chest may be faintly heard. The note is of great strength and volume, and is still distinguishable a couple of miles away, if the day should be calm. The food, as far as I have been able to ascertain, is gathered from the floating duck-weed and other vegetable matter of the swamps. One has to be on one's guard against the formidable wing-spurs on laying hold of a wounded chaha. On one such occasion, a stroke aimed at my face as I stooped to pick the bird up was very nearly successful; the spur caught in my coat-collar, and I was almost pulled out of the saddle by the bird's weight. I have seen a young bird, as yet unable to fly, beat off and follow up a dog, striking quickly and heavily, the half-folded wings being used alternately. Well might Mr. Durnford express surprise at the breeding-habits of this species. At the end of June (midwinter) he took nests with eggs. But September and October constitute the real breeding season, when the bulk of the birds lay. The nest is a shallow, light construction, built of dry rushes, with a hollow on the top for the eggs. The foundation is in the water. Four is the largest number of young I have seen in one brood; but the clutch of eggs reaches as many as six. These are of a white color, occasionally tinged with light buff, oval-shaped and smooth-shelled. The young, when hatched, is covered with an abundance of beautiful, soft down, of a yellow-brown color. In a very few days they leave the nest and follow the parent birds, generally remaining in the swamps or close to them."

It is needless here to enlarge upon the characters peculiar to the ANATOIDEÆ, the 'duck tribe,' in its widest sense, since few groups are better known to the general reader. It is one of the best circumscribed super-families of recent birds, and its distinguishing characters so well marked externally, that nobody fails to recognize any member at an instant, be it a swan, a goose, a duck, or a merganser, and most of the systematic names invented for the group, as *Lamellirostres*, *Lamellosodentali*, *Serrati*, *Dermorhynchi*, etc.—have been derived from the soft-skinned bill with the curious lamellar teeth. Most of the species take their food under water, and, when the head is raised, the water runs out between the lamellæ, which act like a sieve in retaining the food, which led to the invention of the English word 'sifters,' as an equivalent of *Lamellirostres*. In some forms the lamellæ are shortened and thickened so as to enable them to act as teeth in nipping off grass, as, for instance, in the geese, while in the mergansers they are modified into retrorse hooks, which serve to prevent the slimy fish from slipping away. Some of the more important anatomical characters have been mentioned under the foregoing super-family, and others will be mentioned when we describe the peculiarities of the flamingos.

Ducks, and their allies, are found all over the globe. Man has found them wherever he went, and he has seen them flying northwards at the northernmost point he has reached.

The first form to meet us of the 'duck tribe,' in its widest sense, is one of those remarkable extinct birds which formerly inhabited the islands of New Zealand, and which lost their power of flight through disuse of that faculty, and consequent degeneration of the parts. Though originally described in connection with the Moa remains, and found together with them, the *Cnemidornis*, as it was called by Owen, has nothing to do with *Dinornis*, or the Struthious birds at all; its ilia and ischia are united behind, the sternum has trace of a keel, and the palate is desmognathous. It differs, however, sufficiently from the typical *Anseres* to require the separate position of a very marked family which we will call CNEMORNITHIDÆ.

The greater part of a well-preserved skeleton, from which Dr. Hector demonstrated the affinities of *Cnemidornis* to the Anatoidæ, was found in the same cave which furnished the very interesting specimen of a moa's neck with muscles, skin, and feathers, referred to on a previous page. It differs in several important respects from that described by Owen as *C. calcitrans*, the principal discrepancy being the greater proportional size and somewhat different structure of the humerus, and may be specifically distinct. The skull proves the relationship to the Anatoidæ, but is remarkably robust and short, the palatines are firmly united posteriorly with the vomer, the upper surface of which has a slight groove to receive the præsphæmoid; the basisphenoid has large oval basiptyergoid facets; anterior nostrils large, holorhinal; a soft cere has probably covered the basal part of the mandibles, while only the part in front was horny, as in *Cercopsis*; the character of the tympanic cavity is quite peculiar, being bridged across by a bony process between the mastoid process and the basioccipital. The breast-bone is large, deep, nearly square, and without indentations or processes behind; it has a trace of a low keel in the anterior part, which rises less than one fourth of an inch above the convex surface. The metacarpal elements are completely fused at both extremities, the length being about two fifths of the length of the humerus. The first six ribs had well-developed uncinate processes.

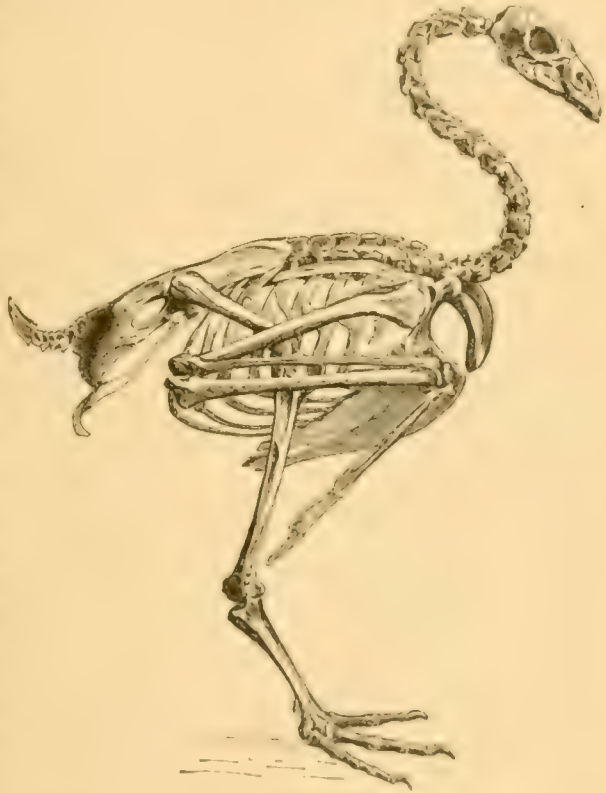


FIG. 63. — Skeleton of *Cercopsis*.

The pelvis is very robust; the ilium and ischium unite posteriorly, closing the ilio-sciatic foramen behind. In the hind limbs we note the peculiarity of the presence of a high epinenial process, as in *Colymbus*, in front of the knee-joint, and hence the name.

Dr. Hector estimates the height of the bird's back above the ground to have exceeded two feet, and the total length to have been at least three feet.

That the nearest living relative of *Cnemidornis* hails from Australia, and is quite peculiar internally and externally, cannot but strike us as natural in view of our experience with other groups. A glance at the admirable full-page cut representing *Cercopsis nova-hollandiæ*, the only species of the family CERCOPTIDÆ, shows us at once a bird in general aspect resembling a goose, but provided with a quite unique bill, a heavy and short frame, very stout feet, and deeply indented palmation of the

toes. The bill is short, very thick at base, its upper outline strongly convex; nearly the whole beak to a little behind the large nail is covered with a tumid cere of a lightly greenish yellow color, in the anterior part of which the roundish nostrils open. In regard to the peculiarities of the skull itself we only speak of the proportionately short lachrymal region, a part which in typical *Anseres* is very much elongated. The keel of the sternum is very deep, its inferior edge very curved, and the anterior angle pointing comparatively far forwards.

The color of the *Cereopsis*, or Cape Barren goose, as it is called by the colonists, is of a beautiful brownish ash, lighter on the top of the head, and with roundish black spots on the wing-coverts. The eye is vermilion red, the tarsus orange, and the toes and webs blackish. Anomalous as is the structure of this bird, its habits are not less so, it being a 'swimmer' which carefully and entirely avoids the water. It inhabits the interior dry plains, its diet being, of course, exclusively vegetable. It is a 'swimmer' and 'sifter' modified into a 'grazer.' Needless to say that its dark flesh is delicious eating, and, consequently, these shy birds have been persecuted mercilessly both by the natives and by the white settlers, the result being that the *Cereopsis* had become so scarce, as early as Gould's travels in Australia, that 'the old bushman' only met it twice in a wild state. It breeds, however, in confinement, and is easily tamed, but as it is very pugnacious and imperious it is not a desirable addition to the poultry-yard, and the rather extensive domestication of this bird, which sprang

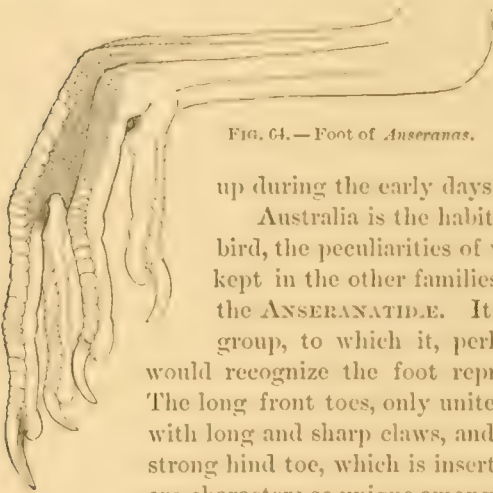


FIG. 64.—Foot of *Anseranas*.

up during the early days of the colony, has gradually subsided.

Australia is the habitat of another not less remarkable goose-like bird, the peculiarities of which seem to us too great to allow it to be kept in the other families, and hence we would make it the type of the ANSERANATIDÆ. It has usually been referred to the following group, to which it, perhaps, may also be nearest allied, but who would recognize the foot represented in the cut as that of a goose? The long front toes, only united at base by a small membrane, and armed with long and sharp claws, and especially the remarkably lengthened and strong hind toe, which is inserted nearly at the same level as the others, are characters so unique among *Anseres* that a separate position can hardly be denied the owner, and the feet, indeed, strongly suggest those of the screamers. The bill is also very peculiar, a warty skin covering the beak from the nail and the face to behind the eyes. The convolutions and position of the windpipe are most extraordinary and deserve to be mentioned. Yarrell, who made this part of the bird's anatomy a special study, describes the windpipe thus: "The trachea is situated on the outside of the left pectoral muscle, under the skin, sufficiently raised under the wing that respiration would not be impeded when the bird rested with its breast on the ground, the parallel tubes being firmly attached both to the muscle and the skin by cellular tissue. The clavicle of the right side of the bird is of the usual character, but that on the left is both shorter and wider, having an aperture about the middle, the sides diverging with a projecting point on the inner side, to which the tube of the trachea is firmly attached, about two inches above the bone of divarication. The trachea lying on the left side of the bird, the lower portion of the tube, in its passage to the lung, crosses the left branch of the furcula at a right angle,

but, becoming attached to this projection of the clavicle, receives from the point described its central direction into the body. The whole length of the windpipe is four feet eight inches."

The semi-palmated goose (*Anseranas semipalmata*) is a large, striking-looking bird, glossy, greenish black, with the shoulders, rump, breast, and abdomen pure white. Its voice is said to be a loud whistling.

Dr. G. Bennett, in a letter to Mr. Gould, speaks of it in the following manner: "The semi-palmated goose I have seen domesticated in Sydney in a poultry-yard,



FIG. 65.—*Plectropterus rufipellii*, spur-winged goose.

having been hatched by a common hen. This bird in its anatomy evidently approaches the cranes, and in habits also. Especially when you see it running about the poultry-yard, it resembles one of the Gruidae more than a goose." And again he says: "The black and white plumage imparts to the bird a very handsome appearance as it walks with a stately tread (not with the waddling gait of the goose) about the yard of my house, like one of the waders." He further states that they are easily tamed, are very amicable to the other poultry, but require company in order to thrive. The flesh, however, is said to be coarse and not well-flavored. This species inhabited southern, southeastern, and northern Australia, but seems to have been driven away from the southern parts by the progress of cultivation. At Dr. Leichardt's time they

were so numerous, and the flocks so dense in the north, that the natives were enabled to procure numbers by spearing them when flying.

Nearly related to the above species are the African PLECTROPTERIDÆ, or spur-winged geese. As the name indicates, the bend of the wing is provided with a strong spur, and the legs are rather high, and placed well under the middle of the body. There are three or four species of the genus, *Plectropterus*, one of which, *P. rüppellii*, from eastern Africa, with the high frontal knob, is here figured.

Mr. T. Ayres gives the following account of the habits of the knobless but nearly related *P. gambensis*, from the western and southern parts, as he observed them in the Transvaal: "This is the commonest of our wild geese, and is by no means capital



FIG. 66. — *Alopochen aegyptiaca*, Egyptian goose.

eating, as the flesh is coarse and tasteless, and the young birds have scarcely any meat on them. Sometimes they are very shy, and at others almost absurdly tame; as a rule, it requires heavy shot to kill them. They come out early in the morning from the swamps and reeds to feed on grass-seeds, and are often seen on the farmer's cornlands: if stalked in the long grass, they will almost invariably creep away, instead of taking wing; and, unless the hunter has a dog, it is no easy matter for him to find them, as they run at a good pace, and by the time he is on the spot expecting them to rise, he sometimes sees the head of one a couple of hundred yards off, examining the situation; if the shooter squats when the birds are flying, they will often come and have a look at him, and this curiosity frequently costs them their lives. As a

rule they are gregarious, but are sometimes seen singly, and at others in pairs; they breed away from the water in thick, grassy, or rushy spots, and lay a number of white eggs with thick, glossy shells."

Another African form of the same family is the well-known Egyptian or Nile goose (*Alopochen aegyptiaca*). It is often found figured on the Egyptian monuments, and was known to the ancient Greeks, who called it 'chenalopex,' or fox-goose, either because it breeds in burrows, or on account of its color, which is more or less rusty, especially round the eyes, neck, tertials, and a spot on the breast. The smaller wing-coverts are white; a green speculum marks the large coverts; bill and feet are brilliant red; a small frontal knob black. As the name indicates, it is an inhabitant of eastern Africa, but is often shot in England and other countries of temperate Europe, though

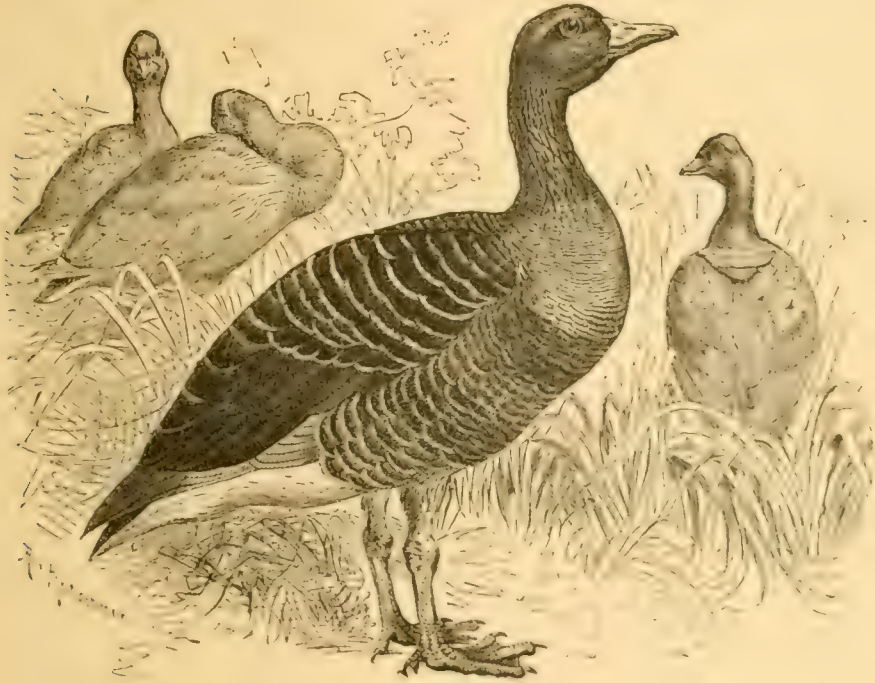


FIG. 67.—*Anser anser*, gray-lag goose.

probably many specimens have been birds which have escaped confinement, for this stately bird, in size equalling the common goose, is often kept for ornament in parks and gardens, also in this country; and the one which was shot on Long Island in 1872 evidently came from this source. The Egyptian goose has no close ally in the Old World, and it is a somewhat extraordinary fact that the Orinoco goose (*A. platyrhynchos*), brown, with green wings and white wing speculum, head, and neck, and with a slight nuchal crest or 'mane,' which inhabits northeastern South America, seems to be congeneric with it.

Having now disposed of the most outlying forms, there remains the great bulk of the ducks, which we unite in the family ANATIDÆ, comprising the geese, swans, tree-ducks, ducks proper, and mergansers, groups which may be regarded as affini-llim. The goose proper form a well-circumscribed group, characterized by a bill rather high at base, com-

paratively short and strong; the lamelle hardly deserve that name, being short, broad at base, tooth-like, and altogether adapted to the grazing habits of these birds. The body is stout, and the legs placed near the equilibrium, so as to make the movements on land less awkward than in most ducks. The plumage of the neck is rather peculiar, the feathers being narrow and arranged in oblique series into more or less conspicuous ridges and grooves. The two cuts represent two of the most important genera, the gray-lag being the type of *Anser* proper, the land-geese, while the common brant (*Branta bernicla*) shows the chief characters of the sea-geese, which feed particularly on the sea-grass. The gray-lag goose (which, by the way, is the wild stock of the domesticated goose) and its allies are restricted to the boreal regions, while the bernicle geese are equally well represented in the southern hemisphere, particularly in antarctic South

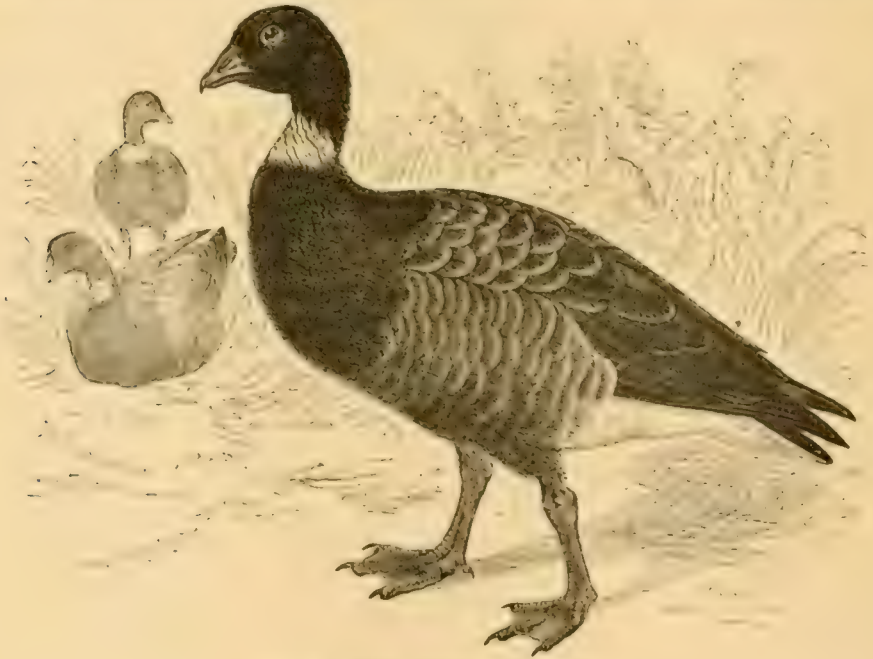


FIG. 68. — *Branta bernicla*, common brant.

America, where several handsome species, peculiar by the metallic reflections of the wing speculum, have their home.

One of these, *Chlaephaga melanoptera*, inhabits the high Andes of Peru and Bolivia, as high up as 14,000 feet above the sea-level, and has not been met with south of 35° south latitude. It descends in winter to the plains, but retires in summer to the high Cordillera, to the verge of the line of perpetual snow. Another beautiful species is the emperor-goose (*Philacte canagica*), from islands in Bering's Sea and Alaska. Besides these there are numerous other kinds, of which we can only mention the names, the red-breasted brant (*Rufibranta ruficollis*), from eastern Siberia, the barred-headed goose (*Eulabeia indica*), from India, the swan-goose (*Cygnopsis cygnoides*), from China, the Hawkesbury bernicle (*Chlamydochen jubata*), from Australia, etc. We will have to stop a moment, however, to consider a genus, containing only a few diminutive species of geese, the so-called goslets (*Nitopus*), of which representatives

are found in South Africa, Madagascar, India, and Australia. Notwithstanding their size, which is not greater than that of a teal, they are true geese with a typical bernicle bill. They are excellent swimmers, however, and pass the greater part of their life on the water, thus differing from most other geese. The Indian species (*N. coromandelicus*), is described as having a peculiar shuffling gait when on land, as "after walking a few steps they always squat." Jerdon thinks it probable that in the wild state they never alight on the land.

The swans are distinguished by the extraordinary elongation of the neck, which is affected by the great number of cervical vertebræ, and not by their being unusually lengthened, as is the case with most other long-necked birds. There are no occipital foramina as in most other ducks, and the pelvis is considerably lengthened and rather narrowed in the postacetabular region. The feet are placed far back, indicating that the swans are more at home on the water than on the land, as is also evident from the shortness of the tarsus. The base of the bill, which is anatine in its form, and the loreal region are naked in the adults. The swans are highly ornamental on ponds and lakes, and several of the species are kept in semi-domestication for that purpose, especially those with a gracefully curved neck. They inhabit the temperate regions both north and south of the equator, one genus with one species being peculiar to Australia, one to South America; one genus is circumpolar, and the fourth is Palearctic; Africa alone has no swans at the present day. This group is apparently nearer related to the ducks proper than to the geese, but from the caverns of Malta is known a gigantic fossil form, *Palæocygnus fulconeri*, which, on account of its high, stout, and short-toed feet, seems to take an intermediate position between geese and swans.

The discovery of Australia altered many an Old World notion in regard to animals and plants, and the saying "white as a swan" had to be modified when the Australian black swan (*Chenopsis atrata*) was discovered towards the end of the last century. It is a most beautiful species; the neck is very long and thin, its curvature very graceful, and the inner wing-feathers are curled and raised; the color is entirely dull black, with white on the wing; the eye is red, and the bill vivid carmine, adorned with a white cross-band. It is entirely acclimatized in the northern hemisphere. The white swans of the genus *Olor*, of which two species are peculiar to the Palearctic region and two to this continent, do not carry their neck in an S-like curve as do the other forms, but straight, more after the fashion of the geese. They have a loud and sonorous voice, the resonant quality of which is due to the convolutions of the windpipe within the breast-bone, similar to the arrangement already described in some cranes. The trumpeters or whistling-swans breed chiefly in the Arctic regions, migrating southwards in winter. Somewhat similar in appearance, on account of the dazzlingly white plumage, but differing in having a most elegantly S-like neck, a high frontal knob, wedge-shaped tail, and simple windpipe, is the European so-called tame or mute-swan (*Cygnus gibbus*), the habitat of which seems to be the western temperate portion of the Palearctic region. When this snow-white bird with the scarlet bill is leisurely swimming, the wing-feathers half raised like sails, and the neck doubly curved, it certainly is one of the most majestic and beautiful members of the feathered tribes. Among water birds it has no rival on the northern half of the globe, and it is very doubtful if it does not even excel the South American black-necked swan (*Sthenelides melancorypha*), the exquisite grace of which is beyond description. The plumage of the last-mentioned species is of the purest white, except on the head and neck, which are of a velvety seal-brown of the darkest shade, in the most striking con-

trast. The bill, which bears a double frontal knob at base, is light plumbeous; the knob, intense rose-color, the nail whitish; the legs are flesh-colored. This species, the smallest of the swans, inhabits South America, from Chili, across the continent, and southward to Tierra del Fuego and the Falkland Islands. Mr. Gibson gives some notes on its occurrence and habits in Buenos Ayres, from which we select the following: "As there are a great many swamps and fens here, it is but natural that all the water-fowl should be represented in extraordinary numbers; and accordingly even



FIG. 69. — *Chenopsis atrata*, Australian black swan.

swans are nearly as abundant with us as ducks are in other districts. I have counted about two hundred on one small lagoon in a swamp; and the latter is but one in a whole network of swamps and watercourses. Another great fen, bordering our land, is known as the Cañada de Cisneros, or Swamp of the Swanneries, an eminently suggestive name for the oologist, one which its character well bears out. About the beginning of the century, the first Christians (so-called in contradistinction to the Indians) who reached this district were Gauchos, who, in pursuit of swans for the sake of their skins,

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Baleniceps rex. shoe-bill.



Aptenodytes longirostris, king penguin.



Archæopteryx lithographica.

made occasional excursions from inside the frontiers. Their weapon was the 'boleadores,' or balls, of the same nature as those used for catching cattle and horses, and which are now sufficiently well known for me to dispense with a description of them. These 'swan-balls' differed only in being made of wood, so that they should float on the water if the Gaucho missed his aim. The swans were tamer and easier to approach then, and the rider took care always to come down the wind, getting within forty or fifty yards before they took the alarm. Then a desperate push, if the water was not too deep, would gain another ten yards, as the swans are taken at the disadvantage of being compelled to rise *down* the wind. The balls are whirled, thrown, and, twisting round the wings and neck of the bird selected, render it quite helpless. Nowadays it is difficult to get within gunshot-range without regular stalking. It nests very early, July and September, however, being the favorite months. The position chosen is always in one of the largest and deepest swamps, the nest being placed among the thickest rushes, at some distance from one of the lagoons, but connected with it by a lane of clear water; for the birds always leave the nest by swimming. It is built from the bottom of the swamp, sometimes through four or five feet of water, above the surface of which it rises a foot or a foot and a half. The diameter at the top is about two feet. The general clutch of eggs is either three or four. They are of a smooth, glossy cream-color."

The Anatinae comprise the group of sub-family rank, which, with a general term, we call 'ducks,' including within it tree-ducks, river-ducks, sea-ducks, and a few minor sections, which at present we cannot satisfactorily place elsewhere. The common character is the shape of the bill which is constructed upon the plan of that of the tame duck, rather broad, more or less depressed, with thin and flat lamellae and mostly narrow nail, but modified in many ways to conform to the requirements of the different habits and the different food of the members. The sub-family is rather numerous in species, and somewhat polymorphic, for some of the forms show strong affinities towards the swans, others to the spur-winged geese, others again to the mergansers.

It will here be necessary to go a little into details in describing the peculiar bulbous enlargement of the windpipe so characteristic of most ducks, since in most works of a general character this feature is usually dismissed by simple mention that such an enlargement occurs. In the females the windpipe descends regularly to the lower larynx, where it becomes more or less contracted. The rings coalesce into a small pyramid with bony walls, from which the two bronchi depart. In no species known has the female an enlargement like that of the male, with the exception of the Australian *Virago castanea*, the female of which has an arrangement similar to that of the male, but smaller, as shown by Prof. Newton. The peculiar structure of the male windpipe consists in a round, bony, bladdery appendage, situated on the left side, just above the bronchial tubes, forming the so-called labyrinth, or *bulla ossea*. This appendage is only absent in a few sea-ducks. In the fresh-water ducks it is of a pretty uniform structure, as typified by the labyrinth of the mallard. Nevertheless every species presents minor differences which are constant and peculiar to it. The sheldrake (*Tadorna*) has a double labyrinth, with the enlargement on the right-hand side. In most of the sea-ducks, the labyrinth is of a somewhat different structure, it being not uniformly osseous all round, but more or less angular, pierced through by numerous openings, the so-called fenestræ, which are covered by membrane. This difference has been regarded as of systematic importance in separating river-ducks and sea-ducks; but the fact that the presence or absence of a lobe to the hind toe is not co-extensive

with a fenestrated or closed labyrinth renders the character useless as such. As examples may be quoted the common eider, which has a labyrinth much like that of the mallard, while it is fenestrated in *Sarkidiornis* and *Rhodonessa*. Some species have, in addition to the labyrinth, or alone, a bulbous expansion higher up on the trachea, as in the rosy-billed duck (*Metopiana peposaca*) from South America, without lobe to the hind-toe, and in the velvet-scorer (*Oidemia fusca*), one of our common sea-ducks.

We shall now briefly review the minor groups into which this sub-family is divisible, commencing with the tree-ducks, which seem to be somewhat isolated, and, perhaps, might have been made to form a separate sub-family in connection with the Muscovy duck and the genus *Sarkidiornis*. The tree-ducks (*Dendrocygna*) are remarkable for their long thin neck, the long hind-toe, their arboreal habits, and their curious geographical distribution. The genus consists of about a dozen forms, which inhabit the tropical regions of the earth, chiefly America and the Malayan archipelago, but also India, Madagascar, Africa, and Australia. This general distribution is not so strange, since we have numerous parallels, as repeatedly observed on previous pages. But in this case we are confronted with the fact that one species, *D. viduata*, occurs both in Africa and in South America. Dr. Selater, however, thinks it probable that it has been introduced to the latter country by negro slaves, but we are not aware that this is more than a mere guess. The Muscovy duck (*Cairina moschata*), originally neotropical, but now domesticated nearly all over the earth, is too well known to detain us further, and the 'black-backed geese' (*Sarkidiornis*) need only be mentioned for the curious, compressed, high wattle, that surmounts the culmen for nearly the whole of its length. The three species, one of which is found in South America, one in South Africa and Madagascar, and one in India, are exceedingly alike, and were once thought to be only one species, making one more instance of the kind of geographical distribution alluded to above.

Not very distantly related to the foregoing genera are the true sheldrakes, *Tadorna*, of which the typical species (*T. tadorna*) is well worth mentioning. Considering its striking coloration, the head and neck being greenish black; anterior part of back, sides, and breast rusty brown, shoulders and middle of under parts black; wing-speculum green, rusty brown behind; bill and frontal knob bright carmine, legs flesh-color, it will be perceived that it is one of the most striking-looking ducks. The size is that of a mallard, but it stands higher on the legs, and looks much statelier and walks better, on account of the more central position of the feet. The sheldrake inhabits the coast of temperate Europe, and is also found in corresponding latitudes on the eastern shores of the Palearctic continent. It is sedentary, and, in spite of its unlobed hind toe, is strictly confined to salt water. The plumage is only molted once a year; there are no seasonal changes, and both sexes are nearly alike in coloration. Its breeding history is most interesting, for it nests in burrows made in the sand-dunes of the coast, either made by themselves or other burrowing animals, as rabbits or foxes. The inhabitants on several of the small sandy islands off the western coast of Jutland—notably the island of Sylt—have made the whole colony of sheldrakes breeding there a source of considerable income, by judiciously taxing the birds for eggs and down, supplying them, in return, with burrows of easy access, and protecting them against all kinds of injury. The construction of such a duck-burrow is described by Johann Friedrich Naumann, who says that all the digging, with the exception of the entrance-tunnel, is made from above. On top of a small, rounded hill covered with grass, the breeding chambers are first dug out to a uniform depth of two to three feet. These

are then connected by horizontal tunnels, and finally with the common entrance. Each breeding chamber is closed above with a tightly-fitting piece of sod, which can be lifted up like a lid, when the nest is to be examined and plundered. Such a complex burrow may contain from ten to twenty nest-chambers, but in the latter case there are usually two entrances. The birds, which, on account of the protection extended to them through ages, are quite tame, take very eagerly to the burrows. As soon as the female has laid six eggs the egg-laying commences, and every one above that number is taken away, a single bird often laying twenty or thirty eggs in a season. The birds are so tame, that, when the lid is opened, the female still sits on the nest, not walking off into the next room until touched by the egg-gatherer's hand. When no more fresh eggs are found in the nest, the down composing the latter is also collected, being in quality nearly equal to eider down.

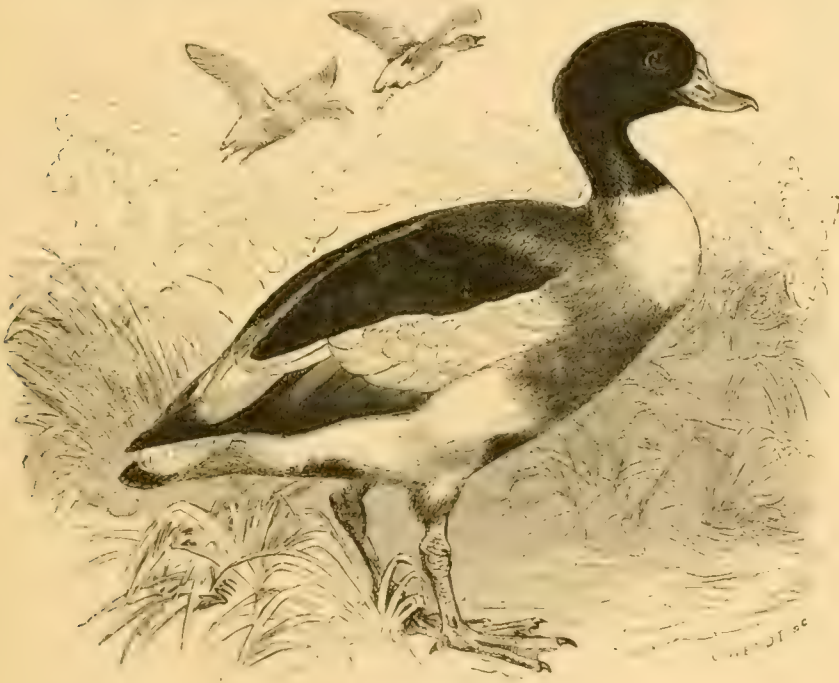


FIG. 70. — *Tadorna tadorna*, sheldrake.

The coscoroba duck (*Coscoroba coscoroba*), is a South American form which, on account of its large size, graceful neck, and white color is usually referred to the swans. It is a true duck, however, as proven both by external and internal characters.

The true and typical ducks (Anatinæ), the central and most numerous group of the family, are conventionally divided into two smaller divisions, according to the presence or absence of a membranaceous lobe to the hind toe, but while there generally is an easily appreciable difference between a river-duck and a sea-duck, several forms are so completely intermediate that it is nearly impossible to decide to which category they should be referred. As far as we know, there is no character, external or internal, that will naturally divide the sub-family in two. As to the value of the formation of the trachea and its labyrinth, we have already spoken above. The sub-family is a tolerably homogeneous one, and only few outlying forms belong to it.

Some species have one or the other organ extremely developed or abnormally developed, as the common shovellers (*Spatula*) and the lobe-billed shovellers (*Malacorhynchus*), which have the bill extremely expanded towards the extremity, and the lamellæ very long and thin, like a horny fringe around the tomia; the latter, an Australian species of peculiar coloration, light brownish gray with dark lunules, giving the plumage a scaly appearance, and a small, glossy, pinkish spot behind the eye, has besides, a soft membranaceous flap attached to each side of the anterior part of the bill. The male mallard (*Anas boschas*) has some of the upper tail-coverts recurved in a peculiar manner; the mandarin-duck (*Dendronessa galariculata*), from Eastern Asia, has a ruff on the side of the neck, and the inner tertial modified into an erect fan or sail-like ornament; the pin-tail (*Dafila acuta*) and the 'old squaw' (*Clangula hyemalis*) have



FIG. 71. — *Spatula clypeator*, shoveler-duck.

the middle tail-feathers extremely lengthened and pointed; the scoters and surf-ducks (*Oidemia*) have a variously formed knob or tumor at base of the bill; many forms have shoulder-feathers and tertials greatly lengthened and pendant, etc.; but all are closely connected otherwise. The geographical distribution offers no peculiarities of a general nature, except that the sea-ducks are more numerous in the boreal regions than elsewhere.

Some of the most tastefully and delicately colored birds are found among the ducks, and some of the rarest colors in the class are here met with. We have already mentioned the pink spot behind the eye of the lobe-billed shoveler. An Indian species, *Rhodonessa caryophyllacea*, remarkable as a fresh-water-duck with the wind-pipe of a sea-duck, is still more extraordinarily colored, both sexes having the head and the back of the neck of a beautiful, pale, rosy pink, with a small tuft of still

brighter rosy on the top of the head in the breeding-season. Mr. F. B. Simson, in 'The Ibis' for 1884, gives some interesting notes about this lovely duck, and tells how, during a shooting-party at Purneah, he secured a couple of specimens for Dr. Jerdon as follows: "Whilst going on I marked a small party of pink-headed ducks into one of the pools, and immediately told Jerdon that if he would leave the party and come with me I thought I could get a nice shot at his long-coveted birds. So we took four elephants and started. Of course with noisy, splashing animals any approach to ducks was impossible; on the other hand, the pool was full of huge crocodiles. We could see them with our glasses. However, I agreed to go on foot, the elephants to come to me the moment the shots were fired. I passed through the tall bamboo-grass in water deepening till it was nearly up to my waist as I came to the edge, and found myself about twenty yards from ten or a dozen of the ducks. They were not sitting close together, so I shot the finest with one barrel, and another as they rose, and I made off to the elephants as hard as I could. Once safe on Behemoth, I surveyed with Jerdon the sight, familiar to every Indian ornithologist, but always enjoyable and never to be forgotten, of the wonderful variety of bird-life to be seen in a spot like this. After having discussed all the species we saw, we examined the two pink-headed ducks we had picked up with the aid of the elephants. Jerdon was delighted with them, and said that the pink of the head was far more beautiful than in dried specimens." -Mr. Simson states that this species is far from uncommon in a restricted area of Bengal, its home being the southern part of the district of Purneah, and in the country bordering the left bank of the Ganges, between the Coosy River, which separates Purneah from Bhagalpore, and in the Maldah district. For various reasons it is little known, however, to the Bengal sportsman and ornithologist, and is considered rare, the chief reasons being that it is poor on the table, and that it is never very numerous, nor goes in flocks, nor associates with other ducks. It is resident all the year round, pairing and nesting in short grass on dry land at some distance from the pools.

At the southern extremity of South America lives a singular sea-duck, with lobed hind toe, which, on the other hand, seems to have the trachea of a fresh-water duck. The early travelers, on account of its curious habits, bestowed upon it the cognomen of the 'race-horse duck,' but those of the present century prefer to call it the 'steamer duck' or 'side-wheel duck,' "on account of its movements when swimming presenting a strong resemblance to those of a paddle-wheel steamer." Others call it the 'logger-head duck,' and its systematic name is *Tachyeres cinereus*. At one time it was thought that there were two species, one incapable of flight, the other possessed of volant powers, but Mr. R. O. Cunningham seems to have established the fact that the 'flying logger-head' is only the young bird, and that the power of flight departs from it as it grows old, or, to use Cunningham's own words, "that, as the bird increases in size and weight, owing to the deposition of an increased amount of mineral matter in the bones and various other causes, it gradually abandons the habit of flight, finding that the speed with which it can progress through the water by means of the rapid movements of its wings, together with its diving-powers, are sufficient to preserve it from threatened danger."

The eiders form a particularly striking group among the sea-ducks, also peculiar in some structural characters, having an unfenestrated labyrinth like the foregoing species. Also, in the great difference in the coloration of the sexes, and in the males assuming the plumage of the female for a short season following the breeding, they

approach the river-ducks. They inhabit the boreal regions, and in countries where they are numerous and protected, they are of considerable economical importance, the down of which they build the nest being highly valued. Each nest yields about an ounce and a third. From Greenland and Iceland alone six thousand pounds, or the contents of seventy-two thousand nests, are yearly exported. This gives an idea of



FIG. 72. — *Somateria mollissima*, eider-duck.

the number of these birds in the high north. All along the coast of Norway, where the bird is protected by law throughout the year, the common eider (*Somateria mollissima*), is now exceedingly common and very tame. The inhabitants take great care of the breeding birds, which often enter their houses to find suitable nesting-places, and cases are authenticated in which the poor fisherman vacated his bed in order not to disturb the female eider, which had selected it as a quiet corner wherein to raise

her young. In another instance the cooking of a family had to be done in a temporary kitchen, as a fanciful bird had taken up her abode on the fireplace.

Nearly related to the eiders is one of our North American sea-ducks, the history of which is extremely interesting. We refer to the Labrador duck (*Camptolaimus labradorius*), which, to all appearance, is now extinct, or at least very nearly so, since no capture of a specimen has been reported since December, 1878, while during the preceding ten years scarcely more than half a dozen birds were obtained. Altogether only three dozen specimens are preserved in collections, of which eleven are in Europe, the remainder in North America. The Labrador duck, consequently, is twice as rare in museums as the great-auk. As it was a good flyer, the circumstances which led to its destruction must have been quite different from those extinguishing the auk. Within historical times its distribution seems to have been very limited (the north-eastern Atlantic coast, presumably breeding in Labrador and migrating southwards in winter as far as the Chesapeake), but it has always been comparatively rare, even at the time of Wilson. It is difficult to say what ultimately brought on their extermination, and the suggestion of an epizooty may be as good as any, but I would submit another possibility. It seems to be a fact that when a migratory species has reached a certain low number of individuals, the rapidity with which it goes towards extinction is considerably increased. Two circumstances may tend towards this result. We know that when birds on their migrations get astray, having lost their route and comrades, they are nearly always doomed to destruction, that fate not only overtaking single individuals, but also large flocks to the last member. If the safety of the wanderers, therefore, greatly depends upon their keeping their correct route, then safety decreases disproportionately the scarcer the species becomes, since, if the route is poorly frequented, the younger and inexperienced travelers have less chance of following the right track, and more chance of getting lost, and consequently destroyed. The fewer the individuals, the more disconnected become the breeding localities, the more difficult for the birds to find each other and form flocks in the fall. Finally, the number will be reduced to a few colonies, and the species, consequently, in danger of extinction, since a casualty which under ordinary circumstances only would affect a fraction of the members, now may easily prove fatal to all the remainders of the species. We need only suppose that during one unfortunate year nearly all the broods were destroyed by inundations, fires, or frost, to perceive what difficulty the few birds left in the autumn would have in winding their way without getting astray. We know that the proportion of birds returning in spring is comparatively small, and the flocks are considerably thinned down. Under the circumstances presumed, there will hardly be birds left to form flocks. But birds used to migrate in flocks do not like to or cannot travel alone; hence they are forced to follow flocks of allied species, which may take them to localities far from their home. In that way a few scattered pairs may survive, and breed here and there, a number of years after the rest are destroyed, and such survivors are probably those few Labrador ducks which have been captured occasionally during the last twenty years or more. There is a possibility that a few such pairs may still be in existence, but, however hardy, their fate is sealed, and perhaps not a single one will get into the hands of a naturalist.

Well may the *Erismaturinae* be called quasi-cosmopolitan. The group, which is related to the sea-ducks, in reality belongs to the same category as *Rostratula*, *Sarkidiornis*, etc., having one or a few 'aberrant' representatives in South America, Australia, and South Africa, in this case somewhat modified, as no species is found in India,

while one invades the Palearctic region, and one, our ruddy duck (*Erismatura rubida*), is peculiar to North America. The birds of this family are especially characterized by the narrow and rigid tail-feathers, which are only scantily protected with coverts at the base. The strangest bird of the group is the Australian musk-duck (*Biziura lobata*), the male of which has a large, compressed wattle underneath the chin, very much like that which *Sarkidiornis* has on the top of the bill. It very seldom takes to the wing, even when hard pressed, but it dives with great ease and can remain under water for an incredible space of time. Its chief mode of progression is by swimming with the head and part of the neck alone above the surface. The male is nearly twice as big as the female, and the color of both sexes is a blackish brown. During the pairing and breeding season the male emits a strong odor of



FIG. 73. — *Merganser merganser*, European goosander.

musk, which may be smelt long before the bird is seen, and hence the name. The eggs, which usually are only two in number, are comparatively large, and of a pale olive color; the shell is rough and very strong. The peculiar voice of the musk-duck is said to resemble "the sound caused by a large drop of water falling into a deep well."

The last sub-family consists of the mergansers, which are directly and closely related to several of our sea-ducks, but adapted to a diet of living fish instead of the molluscs which serve the sea-ducks for food. In consequence the bill has been greatly modified. The great width, being unnecessary, has been reduced, the lamellae, no longer serving as a sieve, have been changed into strong teeth which will prevent the escape of the unfortunate victims, and the nail has assumed the character of a strong hook. The result is that these birds are among the greatest destroyers of fish life.

The true mergansers—perhaps not more than seven species—are all adorned with a more or less conspicuous crest on the head, our North American hooded-merganser (*Lophodytes cucullatus*) being in that respect the most noteworthy, as it is also altogether the prettiest species of the group.

A small genus of South American ducks are doubtfully referred to this sub-family, and may probably constitute a separate group, viz., the so-called ‘torrent-ducks’ (*Merganetta*). The bill is more like that of the ordinary ducks, but their plumage recalls that of the mergansers, while a sharp and large spur at the bend of the wing is entirely peculiar. They inhabit only the highest Andes from Columbia to Chili, and the rapidity with which they swim and dive against the mountain-torrents is described as truly astonishing.

Among all the curious modifications of the typical bird-beak, none is more strange and aberrant than that of the flamingos (PHIENICOPTERIDÆ). The lower mandible forms a deep and broad box, into which the upper one, which is much lower and narrower, fits like a lid; the sides are provided with quite duck-like lamellæ; and, to complete the oddness of the structure, both mandibles at the middle are bent abruptly downwards. This makes the flamingo a ‘sifter,’ indeed, and the bill is used to great advantage in sifting out the various minute crustaceans, molluses, and vegetable matter which they gather from the soft mud of the salt-water lagoons frequented by them. In feeding, the head is bent forwards until the anterior deflected part of the bill is parallel with the ground. The gullet is remarkably narrow, and allows only the minutest particles to pass into the stomach. In this particular, and also in the lamellæ and the narrowness of the upper mandible, the flamingos present a most striking and interesting analogy to the balaenid whales, the ‘whale-bone’ of which has the same function as the lamellæ of the Anatidæ and the flamingos.

On account of the extreme elongation of the neck (which, by the way, is not caused by a particularly great number of vertebræ, there being only eighteen, but by a prolongation of the individual vertebræ, especially in the middle portion), and also on account of the equally lengthened legs, the flamingos were associated with the waders by the early authors. Some recent ornithologists who still adhere to this view have strengthened it by adducing several anatomical features in support of the affinity to the Herodii, especially to the ibises. According to them the characters of the breast-bone, and still more the pelvis, the number of ribs, the pterylography, and the visceral arrangement point directly toward the latter order. Huxley, on the other hand, thinks that the flamingo is “so completely intermediate between the Anserine birds on the one side, and the storks and herons on the other, that it can be ranged with neither of these groups, but must stand as the type of a division by itself.” This position, however, seems to us indefensible, since the flamingos show no such peculiar characters that warrant their independent position. Combining characters of both, it must belong to one or the other of the two groups, and it does not seem to us that the characters are so nicely balanced as to leave us in doubt in regard to the place of the flamingos, following, as we do, those authors who associate them with the Anseres. It will suffice to mention the following characters: The lachrymo-nasal region is elongated; the frontalia are narrow, not covering the orbit above; grooves for the orbital glands are present; so are also basi-ptyergoid processes, though rudimentary; all characters which are duck-like and not at all herodine, and the furculum and the shoulder-blades are distinctly anserine too. The muscular formula, BXY, points neither way, nor does the pterylosis strike us as so extremely distinct from that of the Anseres. The partly

stork-like arrangement of the viscera, on the other hand, is completely counterbalanced by the strongly and unmistakably anserine nature of the tongue, and by the presence of well-developed cæca. We do not lay much stress upon the external characters, though the lamellæ of the beak, the palmation of the toes, and the number of tail-feathers — there being fourteen in the flamingo, but only twelve or ten in all *Herodiones* — point in the same direction. A peculiar character is the number of primaries, the flamingo having eleven, or one more than most birds. The arrangement of the carotids is also worth mentioning. It is usually asserted that *Phœnicopterus* has only one carotid, the right — a very unusual arrangement, since nearly all birds which possess only one have retained the left one. Professor Garrod, however, has shown that this is a mistake, and that the flamingo has two carotids, though the left one is very small, and unites with the right one at the point where, in allied birds, the two arteries meet in order to follow alongside of each other, — a unique modification, as illustrated by the accompanying diagram.



FIG. 71. — Carotids in *Phœnicopterus*; a, aortic arch; h, origin of aorta; lc, left carotid; li, left innominate artery; ls, left subclavian artery; rc, right carotid; ri, right innominate; rs, right subclavian.

The characters which seem to connect the flamingo with the ibises and storks we regard partly as ancestral, and partly as the result of adaptation to a similar mode of life. On the other hand, placing them, as we do, next to the latter group, we, of course, do not deny their mutual relationship.

The group is now a very small one, only about eight species being recognized at present. Otherwise during earlier geological periods, as there are more fossil *Phœnicopteroid* birds known from the deposits in France alone than are now distributed all over the tropical and sub-tropical world. The type is therefore a rather antique one, and at one time numerous species and genera inhabited the shore of the lakes and estuaries under latitudes considerably north of the present limit of the family. In the eocene beds of France have been found remains of apparently flamingo-like birds, upon which have been based the genera *Agnopterus* and *Elornis*. From the miocene deposits there are described a *Phœnicopterus croizeti*, and not less than five species of the genus *Paluolodus*. As will be seen from the accompanying sketch of the restored skeleton of one of these, they were essentially like the flamingos of the present day in regard to the length of the legs and neck, but the bill was straight and altogether more normal than in the latter, the undeveloped young of which likewise has a straight bill. They very properly constitute the family *PALUOLODONTIDÆ*.

The recent *PHÆNICOPTERIDÆ* embrace only two genera, *Phœnicoparra* and *Phœnicopterus*. The former, which is characterized by its thick, short, and otherwise aberrant beak and the absence of a hind toe, is peculiar to the Andes of Chili and Peru, and consists only of one imperfectly known species, *P. andinus*.

Of the true flamingos the species belonging to the fauna of the United States, *P. ruber*, has been known under this name since the time of Linnæus, but he and his successors during the last century believed it to be conspecific with the Mediterranean species. Bonnaterre, in 1790, and Temminck thirty years later, expressed a belief of their being separable; but Brehm in 1823 seems to have been the first author to take their distinctness for granted, adopting without hesitation the name *P. antiquorum*, which Temminck had only proposed hypothetically.

The flamingos are often kept in captivity, and their manners and habits, so far as they could be observed in a zoological garden, are well known. In the wild state, however, they are extremely shy birds, and of their breeding history nearly nothing was known, the old fable of their riding astride on top of high pyramids being copied from age to age in words and pictures, notwithstanding that Naumann, as early as 1838, demonstrated the anatomical and physiological impossibility of the alleged position of the breeding bird, and in spite of Dr. Cresson's assertions to the contrary. The story originated with the famous traveler Dampier, but from his narrative it is clear that he was only speaking upon hearsay evidence; for when, in 1683, he visited the Cape Verde Islands, he found only nests and young ones, but no eggs; and the account of the breeding is therefore evidently based upon the tales of the natives. It runs as follows:—

“When incubating they stand with their legs in the water, resting themselves against the Hillock, and covering the hollow Nest upon it with their Rumps; for their Legs are very long; and building thus as they do upon the Ground they could neither draw their Legs conveniently into their Nests, nor sit down upon them otherwise than by resting their whole Bodies there, to the Prejudice of their Eggs or their Young, were it not for this admirable Contrivance which they have by natural Instinct.”

His statement has, however, been generally, if not universally, accepted, for want of a better, inasmuch as no competent observer had succeeded until 1881 in watching the manner in which the flamingo performed the task of incubation. Eggs have, indeed, been obtained by the bushel, but the wariness of the birds precluded any trustworthy account until the visit of H. H. Jonston, in 1881, to a small colony in the Lake of Tunis, and of Mr. Abel Chapman, in 1883, to a large one near the mouth of the river Guadalquivir in Spain. The former says: “I took up my opera-glass and saw on two mounds, some foot and a half high, two flamingos sitting *with their legs under them*. Of this I am certain: I could see the tarsi protruding beyond the loose plumes of the wings.” The latter gentleman's account is fuller, so we give the following extract from his narrative:—

“The islands were about six miles distant from the low shores of the ‘marisma,’ and at that distance no land whatever was in sight. The only relief from the monotony of endless wastes of water were the birds; a shrieking, clamoring crowd hung overhead, while only a few yards off the surface was dotted with troops of stilts, sedately stalking about, knee-deep. Beyond these the strange forms of hundreds of flamingos met one's eye in every direction,—some in groups or in dense masses; others, with rigidly outstretched neck and legs, flying in short strings or larger flights.



FIG. 75. — Restoration of the skeleton of *Palaeolodus ambiguus*.

'glinting' in the sunlight like a pink cloud. Many pairs of old red birds were observed to be accompanied by a single white (immature) one. On examining narrowly the different herds, there was an obvious dissimilarity in the appearance of certain groups: one or two in particular seemed so much denser than the others; the narrow white line appeared at least three times as thick, and in the centre it looked as if the birds were literally piled upon each other. Felipe suggested that these birds must be at their 'pajarera,' or breeding-place; and after a long ride through rather deep water we found that this was so. On our approach, the cause of the peculiar appearance of



FIG. 76. — *Phoenicopterus antiquorum*, flamingo.

the herd from a distance became clearly discernible. Many of the birds were sitting down on a low mud island; some were standing on it, and others, again, were in the water. Thus the different elevations of their bodies formed what had appeared a triple or quadruple line. On reaching the spot we found a perfect mass of nests; the low mud plateau was crowded with them as thickly as the space permitted. These nests had little or no height: some were raised two or three inches, a few might be five or six inches; but the majority were merely circular bulwarks of mud, with the impression of the birds' legs distinctly marked on it.

The general aspect of the

plateau was not unlike a large table covered with plates. In the centre was a deep hole full of muddy water, which, from the gouged appearance of its sides, appeared to be used as a reservoir for nest-making materials. Scattered all round this main colony were numerous single nests rising out of the water, and evidently built up from the bottom. Here and there two or three or more of these were joined together, — 'semi-detached,' so to speak; these separate nests rose some six or eight inches above the water-level, and were about fifteen inches across. The water was about twelve or fifteen inches deep. None of these nests as yet contained eggs, and though I returned to the 'pajarera' on the latest day I was in the neighborhood (May 11), they still remained empty. On both occasions many hundreds of flamingos were sitting on their nests, and on the 11th we had a good view of them at close quarters. Linked arm and arm with Felipe, and crouching low on the water, to look as little human as possible, we approached within

some seventy yards before their sentries showed signs of alarm, and at that distance with the glass observed the sitting birds as distinctly as one need wish. Their long red legs doubled under their bodies, the knees [heels!] projecting as far as or beyond the tail, and their graceful necks neatly curled away among their back-feathers, like a sitting swan, with their heads resting on their breasts, — all these points were unmis-takable. Indeed it is hardly necessary to point out that in the great majority of cases (the nests being hardly raised above the level of the flat mud), no other position was possible. Still none of the crowded nests contained a single egg! How strange it is that the flamingo, a bird which never seems happy unless up to its knees in water, should so long delay the period of incubation! for, before eggs could be hatched in the nests, and young reared, the water would have entirely disappeared, and the flamingos would be left stranded in the midst of a scorching plain of sun-baked mud. Being unable to return to the marisma, I sent Felipe back there on 26th May, when he found eggs."

So much for the breeding habits, of which the accompanying cut gives a most excellent illustration. To complete the picture of these interesting birds we add the following, also from Mr. Chapman's pen: —

"In herds of three hundred to five hundred, several of which are often in sight at once, they stand feeding in the open water, all their heads under, greedily tearing up the grasses and water-plants from the bottom. On approaching them, which can only be done by extreme caution, their silence is first broken by the sentries, who commence walking away with low croaks; then the hundreds of necks rise at once to the full extent, every bird gagging its loudest, as they walk obliquely away, looking back over their shoulders as though to take stock of the extent of the danger. Pushing a few yards forward, up they all rise, and a more beautiful sight cannot be imagined than the simultaneous spreading of their crimson wings, flashing against the sky like a gleam of rosy light. In many respects these birds bear a strong resemblance to geese. Like them, flamingos feed by day; and great quantities of grass, etc., are always floating about the muddy water where a herd has been feeding. Their cry is almost undistinguishable from the gagging of geese, and they fly in the same catenarian formations."

ORDER IX. — HERODII.

The limitation of the present order, as it is adopted here, dates back only to 1867, when Huxley founded the 'family' *Pelargomorphæ* for all the desmognathous 'waders' except the flamingos. His action was then cordially welcomed as a relief from the different attempts of separating the larger and hard-billed waders and the *Scelopaceoid* birds, attempts which had failed, since the separation was based upon the length and position of the hind toe, or the condition of the feathering of the face, or the situation of the nostrils, or the nature of the bill, or the condition of the young when leaving the egg, or some other trifling character. Broadly speaking, the group proposed by Huxley consists of three types, — ibises, storks, and herons, which, in addition to the desmognathous character of the palate, agree in having no trace of basipterygoid processes, therein differing from the members of the foregoing order, and in having long 'wading' legs with no full webs between the toes, therein different both from the foregoing order and from that following, the *Steganopodes*. At first the group was generally regarded as a very natural and rather homogeneous one. The only dis-

sent came from those authors who expected to add to the naturalness and homogeneity by including the flamingos, though Professor Parker, it must be admitted, all the time tried to show that the distance of the Pelargomorphæ from some of the schizognathous waders was not so great as most authors were ready to concede since Huxley's scheme of classification had commenced to overthrow the old notions. As to the mutual relationship of the forms included, the views were a little divided, some authors holding that the ibises and storks were more closely allied than the storks and herons, others defending the opposite opinion. The latter are now generally conceded to be right, but so far have some modern anatomical systematists gone as to assert that the ibises are so different from the storks and herons, and so much like the schizognathous waders, that they are better classified with the latter than with the former, Forbes being foremost among the authors recommending this course. Foreible arguments are produced on both sides, but a final decision is extremely difficult, since it seems to depend upon the question whether the desmognathism is so important a character that it counterbalances the many characters in which herons and storks disagree with the ibises, and which the latter have in common with the Grallæ. For obvious reasons we shall not try to solve the question here, but will retain the ibises in this order, though regarding them as a group of equal taxonomic value to the storks and herons combined.

We therefore propose to treat them as a super-family under the name of IBIDOIDEÆ, and shall at once proceed to point out the chief characters by which they differ from the Ardeoidæ. The former, which embrace ibises and spoonbills, are schizorhinal; the posterior angle of their mandible is recurved; occipital foramina are present; the edge of the cranium above the orbits is truncate, indicating the position of the nasal glands; the breast-bone is four-notched behind, like that of the curlews; the accessory femoro-caudal is present. They also differ from the storks and herons in the form of the furculum and its relation to the breast-bone, the number of ribs, and several other characters of more or less importance. Externally the two super-families are easily distinguished by the bill, the Ibidoidæ having it weak and furrowed by a long groove for nearly its whole length.

As indicated above, the present super-family embraces the ibises and the spoonbills, but while the members of these two groups look extremely dissimilar on account of the apparently enormous difference in the shape of their bills, they are otherwise so closely allied as to be hardly allowed more than sub-family rank; hence we recognize only one family, the IBIDIDÆ. The bill of the ibises is more or less cylindrical, and evenly arched from the base, much after the fashion of a curlew's bill. The spoonbills have the beak greatly flattened and broadened, anteriorly widened into a spoon-like or spade-like expansion. The Ibididæ inhabit the warmer portions of the globe, but are not very numerous, some thirty living species being known. Several fossil forms have been described, however; for instance, *Ibis payana* and *Ibidopodia palustris*, from the miocene deposits of France, which are said to show even greater affinities to the curlews than the recent species.

First in the line comes, of course, *Ibis aethiopica*, the sacred ibis of the ancient Egyptians (and of the British Ornithologists' Union). In explanation of the accompanying cut, it may be stated that the head and neck are entirely naked, and the skin black; the feathers of the body are white; the lengthened and disconnected barbs of the tertiaries are beautifully blackish purple.

According to the Rev. E. C. Taylor, the buff-backed heron "does duty on the

Nile as the ibis, being generally pointed out to travellers by dragomans, etc., as the real *Ibis religiosa*." This is due to the fact that the "sacred ibis," to quote Mr. D. G. Elliot's words, "is no longer met with upon the Nile north of Khartum, and I do not know of any authentic account of its having been seen in Egypt in modern times;" and Dr. A. L. Adams finds "no reason for considering the sacred ibis to have been a native at any time of either Egypt or Nubia." A few straggling individuals to lower Egypt have, however, been recently reported. The latter author continues as follows: "No doubt it was imported by the ancient Egyptians; and judging from the numbers which are constantly turning up in the tombs and pits of Sakkara and



FIG. 77. — *Ibis aethiopica*, sacred ibis.

elsewhere in Egypt, and the accounts of Herodotus, Diodorus, Strabo, etc., the ibis must have been very numerous, and, like the brahmin bull in India, 'did as it choosed.' The last-named writer says, 'every street in Alexandria is full of them. In certain respects they are useful, in others troublesome. They are useful because they pick up all sorts of small animals, and the offal thrown out of the butchers' and cooks' shops. They are troublesome because they devour everything, are dirty, and with difficulty prevented from polluting in every way what is clean, and what is not given to them.' The late Mr. Rhind informed me that he found several jars of white eggs, as large as a mallard's, along with many embalmed bodies of ibises, at Thebes. Mummied ibises are usually found alone, but sometimes with the sacred animals; and

although Hermopolis was the patron city of the bird, as Buto of the kestrel and other hawks, we find it also among the tombs of Thebes and Memphis. No doubt the white ibis was imported into Italy and kept about the temples of Isis. It was the emblem of Thoth, the scribe or secretary of Osiris, whose duty it is to write down and recount the deeds of the deceased; in consequence the bird is constantly seen on the ancient monuments under various forms."

The sacred ibis inhabits tropical Africa down to the Transvaal; a very near ally, *I. bernieri*, is peculiar to Madagascar, while another, also very closely related form, *I. strictipennis*, inhabits Australia and several of the Moluccan islands.

In regard to the habits of this famous bird, the "well-known portrait of which greets us — ever welcome — every quarter," we make the following abstracts from the account of Dr. R. Vierthaler, who had rich opportunities for studying these birds in their native haunts. "In the beginning of September they build, in the neighborhood of Khartum, their nests on the mimosas which stand in the middle of the inundated marshes, twenty to thirty on a single tree. The nest is more or less skilfully made, of the size of that of the rook, and woven together of coarse twigs, with an inner layer of fine grass and a few feathers. The eggs, which are of a greenish white, are generally three — rarely four — in number, and the size that of the mallard. It only breeds once a year, but does not confine itself strictly to one quite fixed time, as I found young ones in November of the same size as those taken in the latter part of September, and it is not probable that this was caused by any disturbance during the breeding, since the nests are nearly inaccessible, small boats being entirely wanting. In freedom the ibis shows a considerable cunning, and is so shy that the hunter cannot creep up to it, and almost always follows it in vain. It does not show any fear at all for the natives, and I saw it often among the cattle, quite regardless of the shepherd or any other black man who happened to be quite near. The flesh of the young as well as the old birds is savory and tender, and when well prepared it is a great dainty. The old Egyptians do not appear to have been acquainted with this fact, or they would not probably have embalmed them."

The extent of the feathering on the head and neck is very variable in the ibises, and numerous generic appellations have been created in consequence. In other respects the group is rather homogeneous, and few striking abnormalities can be recorded. A curious modification of the feathers is found in the straw-throated ibis (*Carphibis spinicollis*) from Australia, which has the feathers of the front of the neck and breast changed into stiff and blunt spines, which in appearance and color are surprisingly like short bits of straw hanging down over the breast in front. Both males and females are said to possess this ornament, and, in fact, the sexes are similar in all these birds.

We have already, in the introduction (p. 9), alluded to the fact that the two alleged species of the genus *Guara*, the white and the scarlet ibises, are structurally identical, only differing in coloration as indicated by the names. The scarlet species is a native of northeastern South America, and has only been reported as seen, but not obtained, within our fauna. On account of the brilliancy and pureness of its red color, it is one of the most beautiful water-birds, and as it bears the captivity quite well, it is often kept in the zoological gardens. Here, however, the scarlet coloration soon gives way to a regular rosy tint.

Only one species, namely the glossy ibis (*Plegadis autumnalis*), is distributed over all the warmer regions of the globe. Like its congeners it has nearly the whole head

feathered, except a stripe between the eye and the base of the bill. In that respect they represent the opposite extreme to the sacred ibis.

The name of the spoonbills explains itself, and it is hardly necessary to refer to the accompanying illustration, for no one who ever saw any of these large and beautiful birds with the singular beak mistook it for anything else. The Old World species



FIG. 78. — *Platalea leucorodia*, spoon-bill.

(*Platalea*) are all nearly pure white, while the American spoonbill (*Ajaia ajaja*) is light rose-colored, with brilliant carmine wing-coverts. In their general habits, as in their structure, the spoonbills are only modified ibises. Like these they also fly with outstretched necks, perch on trees, and also generally breed in trees. Messrs. Selater and Forbes have demonstrated that, in certain localities at least, the spoonbill of Europe, *P. leucorodia*, breeds on the ground among the reed-beds. In 1877 they vis-

ited a breeding colony near Amsterdam, in Holland, from the interesting account of which we select the following:—

“Having inspected the cormorants’ breeding-place, we proceeded about fifty yards further through the reed-beds, over a still more treacherous swamp, to the breeding-place of the spoonbills. The nests of these birds were not situated so near together as those of the cormorants, but scattered about two or three yards from each other, with thin patches of reeds growing between them. There was, however, a clear open space in the neighborhood, formed of broken-down reeds, in which the birds were said to congregate. The spoonbill’s nest, in the Horster Meer at least, is a mere flattened surface of broken reed, not elevated more than two or three inches above the general level of the swamp; and no other substance but reed appears to be used in its construction. What the proper complement of eggs would be if the birds were left undisturbed we cannot say, for, as in the case of the cormorants, the nests are robbed systematically twice a week, until the period when it is known by experience that they cannot produce any more eggs. Then at last the birds are allowed to sit undisturbed. At the time of our visit the season for collecting eggs was just past; but we helped ourselves to eight fresh eggs, from different nests, laid since the last collection had been made. During all the time that we were in the reed-beds, the cormorants and spoonbills were floating about over our heads, fully aware that there was an enemy in the camp.”

The characters of the super-family ARDEOIDEÆ having already been stated to be the reverse of those given for the Ibisoidæ, we may at once proceed to treat of the separate families.

Through the wood-ibises, which, indeed, until very recently, in the systems were associated and more or less confounded with the true ibises, we are led into the CICONIÆ, the storks. With a general resemblance to the herons, the storks combine quite important external and internal characters of their own. Of the former it is sufficient to mention the connection of all the anterior toes at the base, the scutellation of the tarsus, the evident, though slight, elevation of the hind toe, and the broadness of the feather-tracts. The internal peculiarities are still more important. The pectoral muscle, which in all members of the super-family is more or less separable into two layers, is completely double in the storks; the ambiens is rarely absent; flexor hallucis sends a special slip to the second toe; an expansor secundariorum is present; in regard to the respiratory organs it is to be remarked that the syrinx has no intrinsic muscles, and that the storks consequently are deprived of voice, and the only sound they produce is a loud clatter, by beating their huge mandibles together; the rings of the bronchi are complete. Rudiments of two caeca are visible.

The storks are diurnal birds, usually of solitary habits, though some of them nest in colonies, as, for instance, the wood-ibises. Their peculiar clattering of the bill in defect of the voice is already mentioned. Their flight is easy, powerful, and quiet. A flying stork may always be told from a heron on the wing, as it keeps the neck directed straight forward, like the ibises, while the heron flies with the neck bent and the head withdrawn so far back as to rest above the shoulders.

The family comprises about two dozen species of a somewhat peculiar geographical distribution. While occurring all over the tropical and temperate regions of the world, they are nearly wanting in North America; for although both the wood-ibis and the jabiru are enumerated in our faunal lists, only the former occurs and breeds regularly in the southern parts of the country, the latter being only an occasional visitor.

Australia also has only one species. The different forms, with the exception of the true storks, are so distributed that it would seem as if a species inhabiting one part of the world is nearer related to those inhabiting distant regions than to those which live on the same continent. The South American maguari stork, for instance, is more nearly allied to the Old World forms than it is to either the jabiru or the wood-ibis, which are both American. The true storks are strictly Palæogæan, while the curious open-bills are Indo-African.



FIG. 79. — *Tantalus loculator*, wood-ibis.

The stork family has been traced as far back as the miocene formation, from the beds of which, in France, A. Milne-Edwards has described a species, *Pelargopappus magnus*.

The wood-ibises form a somewhat isolated group of apparent affinities to the true ibises, with which they were formerly associated by most systematists, and one species, *Pseudotantalus rhodinopterus*, was, indeed, regarded as *the* ibis, — that is, the sacred ibis of the Egyptians, — until the beginning of this century. The resemblance is quite obvious in the sub-cylindrical and gently curved bill as represented in the accom-

panying cut; but the bill is yellow, and the naked face and the feet are red. The plumage is white, tinged with rosy on the wing coverts. It is common throughout the Ethiopian region, but is scarce in Egypt.

The American wood-ibis (*Tantalus loculator*) is especially at home in South America, but its range includes also our southern states. It breeds abundantly in Florida.



FIG. 80. — *Leptoptilos crumenifer*, marabou, adjutant.

The genus *Leptoptilos*, as typified by the African marabou-stork (*L. crumenifer*), white, with a greenish slate-colored mantle, offers some interesting features. Anatomically, the absence of the femoro-caudal with its accessory slip is noteworthy as unique among the storks. A striking feature is the long pendant pouch underneath the flesh-colored and black-spotted naked neck, which gives the birds a peculiar, unattractive, not to say ugly, appearance, as well pictured in our cut. The exact use of the pouch is not yet ascertained; so much is sure, however, that it connects with

the respiratory system, not with the œsophagus, as is the popular notion; Blyth regarded it as a reservoir of air for supply during protracted acts of deglutition in the species which feed upon carrion. They also present another unique feature, as the semi-plumes of the anal region are lengthened so as to protrude beyond and conceal the true feathers, thus forming a downy ornament of a most interesting character. These under tail-coverts are the so-called marabou feathers, which — especially formerly — were used extensively on ladies' hats. Jerdon informs us of the habits of the large Indian species, *L. dubius*, as follows: —



FIG. 81. — *Anastomus lamelligerus*, open-bill.

“In Calcutta and some other large towns, the adjutant is a familiar bird, unscared by the near approach of man or dog, and protected in some cases by law. It is an efficient scavenger, attending the neighborhood of slaughter-houses, and especially the burning-grounds of the Hindus, where the often half-burnt carcasses are thrown into the rivers. In the Deccan it soars at an immense height in the air, along with vultures, ready to descend on any carcass that may be discovered. After it has satisfied the cravings of its appetite, the adjutant reposes during the heat of the day, some-

times on the tops of houses, now and then on trees, and frequently on the ground, resting often on the whole leg (tarsus). The adjutant occasionally may seize a crow or a myna, or even, as related, a small cat; but these are rare bits for it, and indeed it has not the opportunity, in general, of indulging its taste for living birds, notwithstanding Cuvier's statement that its large beak enables it to capture birds on the wing."



FIG. 82. — *Ephippiorhynchus senegalensis*, saddle-billed stork.

The name of open-bill is suggested by a glance at the bird illustrated in the accompanying cut. Towards the end of the beak the lateral margins of the mandibles are separated by a more or less open space, as if they were worn away, so as to assume the shape of a pair of pinchers. The gap between the mandibles is said to exist even in the young individuals, thus not being the result of attrition, as is generally supposed, and the curious shape is believed to be "a provision of nature to enable them to open the shells of the *Unio*, on which they feed." Their principal food being

molluscs, they have also been called 'shell-ibises.' Jerdon tells how he saw a blinded open-bill extracting the whole animal of an *Ampullaria* without breaking the shell, the bird first securing it by its feet and cutting off the operculum. Two species compose the genus *Anastomus*, one from India and Indo-China, the other from the Ethiopian region. The latter, which is the species figured, differs chiefly in having the



FIG. 83. — *Sphenorhynchus abdimii*, white-bellied stork.

feathers of the neck and lower parts ending in a horny lamella, hence the specific name, *A. lamelligerus*. The general color is blackish, shining green, and purple.

The American jabiru (*Mycteria americana*) differs from its Indian and Australian relatives in having the whole head and neck naked, and black, with a flesh-colored ring round the lower end of the neck. In having the end of the bill slightly turned up, the saddle-billed stork (*Ephippiorhynchus senegalensis*) agrees with the jabiru, but it has a peculiar, soft membranaceous shield on top at base of the bill, therein agreeing with the following species (*Sphenorhynchus abdimii*), of which a figure is

also given. These two, furthermore, agree in being the only two storks in which the ambiens muscle is wanting. Both are natives of Africa. The former was met with by Dr. J. Kirk in the Zambesi region. He states that it feeds on snakes, frogs, and fish, which latter it was seen catching in the shallow water of the river Rovuma, by running forward rapidly, so as to make the fish rush past it, when it caught them, keeping its bill all the while in the water. He asserts that they are commonly found in pairs, — never in large flocks. Mr. Ayres says that occasionally, when the pairs are feeding together, they suddenly stop and skip or dance round and round in a small circle, then, stopping to bow to each other, again resume their quaint dance. The bird is white, with the head and neck black, glossed with bronze-green; scapulars and wing and tail feathers black. The bill is described as bright crimson with a black ‘saddle,’ as seen in the figure; the frontal shield bright yellow; shanks and tarsi black, heels and feet brick-dust red. The female is said to have the iris yellow, while it is brown in the male.

The white-bellied stork (*S. abdimii*) is characterized by its short legs. Above, it is greenish purple, the neck brown with purplish gloss. The bill is greenish with orange-red tip. Dr. Alfred E. Brehm writes thus of it in his journal: —

“This bird, especially seeking the presence of men, confidently perches on the tops of those peculiar, round, wedge-shaped straw huts of the interior of Africa, adorned with eggs of the ostrich, and here called ‘tokahl;’ the dweller in the hut rejoices in these ‘birds of blessing,’ as he calls them, and protects them from foreign disturbance; in fact, he offers the same perfect hospitality to every bird which establishes its nest near his dwelling. In the storks’ nests the chattering host of house-sparrows build their nests; on the lower bushes, at hardly man’s height, are seen many old nests of turtle-doves. I sent my servant Aali, in spite of his opposition, up the trees to fetch me down eggs of the storks. He brought me many, three or four from each nest. The Arabs raised a cry of murder, that we disturbed their holy birds, ‘simbere,’ and invoked the curse and punishment of heaven upon Aali and myself, which brought him quite to rage and despair.”

The following account by Sir Samuel Baker is said to relate to the present species. The copper-colored ‘fly-catcher,’ mentioned therein, is thought to be a *Lamprolornis*: —

“During the march over a portion of the country which had been cleared by burning, we met a remarkably curious hunting-party. A number of the common black and white storks were hunting for grasshoppers and other insects, but mounted on the back of each stork was a large copper-colored fly-catcher, which, perched like a rider on his horse, kept a bright lookout for insects, which, from its elevated position, it could easily discover upon the ground. I watched them for some time. Whenever the storks perceived a grasshopper or other winged insect, they chased them on foot; but if they missed their game the fly-catchers darted from their backs, and then returning to their steeds to look out for another opportunity.”

The ibises and storks have generally been regarded as sacred birds by the people among which they occur, and as the Arabs in Africa and Asia are averse to killing or disturbing them, so the European farmer protects the white, red-billed, and red-legged stork (*Ciconia ciconia*) which has built its large nest on top of his house; and those who are not so fortunate as to possess a stork-nest on the roof, fix an old cart-wheel on the ridge, in order to induce a stork family to construct their bulky nest on the foundation thus offered. Year after year the same pair return to the same house, after

having passed the winter in the south, and the farmer and his children greet them joyfully, as if they were members of the family. The storks, when migrating, travel in large flocks. Canon Tristram thus describes his experience in Palestine, in 1881, with the migrating storks: "The stork kept its appointed time, and stalked solemnly over the plains from the 10th April. I never saw one after the 22d April. Up to that date there was a constant succession of arrivals from the south and departures for the north. The most wonderful flight of storks was one which passed over us in the plain of the upper Jordan on 19th April, steering due north, in the long V-like wedges with which we are so familiar in the flight of wild geese. Party after party passed, perpetually changing their leader, and the hindmost of the longest limb frequently crossing over to take the rear of the other limb; but never, countless though their numbers were, did they fly in a mass, or in any other order than that of the wedge."

There remains still to be mentioned two genera of storks in which the structure of the tail is curiously modified. The genus *Dissoura*, with the plumage of the head and neck downy, size small, and with metallic reflections above, inhabits India and Africa, while *Euxenura* is South American. The latter is as large as the European stork, and similarly colored, but with the bill black. Both agree, however, in having the tail proper strongly bifurcated, the outer tail-feathers being much larger than the middle pair. This character alone would make these birds unique within their order, but the tail is still more strangely constructed, for the lower tail-coverts are stiff and longer than the tail-feathers themselves! To a superficial observer it appears as if the tail is white, slightly rounded, and protected at the base by some stiffened black upper coverts, arranged in an abnormal manner, while the fact is that the tail is black, and bifurcate, with white long under tail-coverts! Thus a well-known author in 1877, while monographing the order, in the species diagnosis, speaks of the upper tail-coverts being bifurcate and raven-black! The mistake is easily discovered by a close inspection, for the black feathers have the groove on the under side of the shaft, while the white ones are grooved on the side turned up. Mr. Robert Ridgway, in establishing the genus *Euxenura*, seems to have been the first to understand, and clearly describe, the true nature of these feathers in the American species.

The maguari stork (*Euxenura maguari*), the only known species, is confined to South America. Mr. Gibson says that it is very common in Buenos Ayres, and not entirely confined to the swamps, but is also found on the plains, "at offal, or stalking about in search of snakes, frogs, lizards, rats and mice, locusts, and birds' eggs,—anything and everything, in short." Of a tame maguari, which was called 'Byles, the lawyer,' he relates that it seized snakes by the nape of the neck, and passed them transversely through its bill by a succession of rapid and powerful nips, repeating the operation two or three times before being satisfied that life was totally extinct. "Byles inspired a wholesome respect in all the dogs and cats, but was very peaceable as a rule. One of our men had played some trick on him, however; and the result was that Byles incontinently 'went for him' on every possible occasion, his long legs covering the ground like those of an ostrich, while he produced a demoniacal row with his bill. It was amusing to see his victim dodging him all over the place, or sometimes, in desperation, turning on him with a stick; but Byles evaded every blow by jumping eight feet into the air, coming down on the other side of his enemy, and then repeating his war-dance; while he always threatened (though these threats were never fulfilled) to make personal and pointed remarks with his formidable bill."

In order that the reader may be enabled to distinctly understand the intermediate

position, and, on the whole, the relationship of the perplexing and curious species which alone constitutes the family SCOPIDÆ, we shall here introduce a slight modification of the synoptical table which Prof. F. E. Beddard laid before the Zoological Society of London, in November, 1884:—

	Storks.	Scopus.	Herons.
<i>Pectoral muscle,</i>	Completely double.	Not completely double.	
<i>Ambiens muscle,</i>	Rarely absent.	Always absent.	
<i>Flexor hallucis,</i>	With a special slip to the second toe.		With no slip to the second toe.
<i>Expansor secundar,</i>	Present.	Absent (except in <i>Cochlearius</i> and <i>Egretta</i> .)	
<i>Origin of obtur. int.</i>		Oval.	Triangular.
<i>Syrinx,</i>	Without intrinsic muscles.	With intrinsic muscles.	
<i>Anterior rings of bronchi,</i>	Complete.	Incomplete, closed by membrane.	
<i>Cæca,</i>		Two.	One.
<i>Powder-downs,</i>		Absent.	Present.
<i>Neck, during flight, carried,</i>		Straight.	Curved backwards.

In view of this table one must agree with Prof. Beddard that *Scopus* is in many respects an intermediate type between the Ciconiidae, on the one hand, and the Ardeidae on the other. As *Scopus* also has many peculiarities of its own, especially in the skeleton, we also follow him in separating it as an equivalent family.

The umbrette (*S. umbretta*), as the name indicates and the accompanying cut illustrates, is a sombre-looking bird, dull brownish dusky all over, with a long occipital crest. The bill is rather peculiar: the culmen is elevated at the base, keeled, and curved at the tip, which is hooked; the sides are much compressed, and grooved near the culmen from the base to the tip; the gonys is long and curved upwards, and the nostrils are partly closed by a membranous scale. All three anterior toes are connected with a membrane at base, as in the storks, but the nail of the middle toe is pectinated, as in the herons, and the tarsus is reticulate.

The habits of the bird, especially in nesting and breeding, are nearly as remarkable as its internal structure, and quite as interesting. We first introduce a general account by Dr. Anton Reichenow, who made its acquaintance in western Africa.

"The umber bird is sociable only in a slight degree. It is usually found single except at the nest, in wooded districts, watching for fishes with its neck drawn in, or walking with measured steps in search of frogs which, besides worms, snails, and insects, constitute its food. Its flight resembles that of the ibises, neck and feet being carried straight out, the former, however, as I had the opportunity to observe, slightly curved. Its voice is a harsh quack, similar to that of the spoon-bill. It roosts in trees or passes the night in its nest, which is a very peculiar structure, completely over-vaulted, and shaped like an oven, with an entrance from the side. The interior is said to usually contain several divisions. The diameter of such a nest, which is built of branches and twigs, is five or six feet. The eggs, three to five in number, are white, and resemble those of the storks. It seems to be a stationary resident throughout its range."

Dr. Kirk says that the Africans look on this bird as unfit for food, and also as sacred, or as possessing the power of witchcraft; and to injure it is everywhere regarded as unlucky. He asserts that the colossal nest serves for many years, and Mr. E. L. Layard describes a place where he counted six or eight within fifty yards,

all exhibiting the same form and structure, and some of them containing at least a large cartload of sticks. The latter author also informs us that the nests are so solid that they will bear the weight of a large, heavy man on the domed roof without collapsing. Such an enormous structure is built by a single pair, and the bird itself is not larger than our night-herons.

Remarks similar to those which preceded the foregoing family might equally well apply to the present one, the *BALENICIPITIDÆ*. This too is African, and comprises a single species, which in a somewhat similar way is intermediate between storks and



FIG. 84. — *Scopus umbretta*, umbrette.

herons. Considerable diversity of opinion exists as to its real affinities. Some authors make it unconditionally a heron; others regard it as separate; others again unite it with the umbrette. The anatomy of its soft parts are as yet unknown, so our conclusions have to be based upon the skeleton and the external characters. It appears to us that the shoe-bill (*Baleniceps*) is intermediate between storks and herons, but as the umbrette inclines towards the storks, so does the shoe-bill to the herons. The two birds themselves are also rather closely related, perhaps more so *inter se* than with either storks or herons proper. There seems, however, to be

numerous peculiarities besides, which warrant us in regarding it as the type of a separate family.

The first feature to attract our attention in this singular bird, of which an excellent illustration faces this page, is the enormous bill, broad and swollen, justifying the expression of Prof. Parker that the *Balaniceps* has "in its strange countenance an artistic, if not a family likeness to the crocodile." Most interesting is the groove along the culmen, and the hooked nail at the end, showing a near approach to similar features in the umbrette. The tarsi are reticulate, the anterior toes are entirely deprived of basal membranes, and the middle claw is not pectinate. In the pterylosis it agrees with the herons in possessing powder-down tracts, of which, however, it only has one pair. The skull has been considerably modified in consequence of the exaggerated development of the bill. Otherwise the shoe-bill, in its skeleton, shows many near affinities to the herons, but the sternal apparatus is rather stork-like, with some very remarkable peculiarities of its own, as shown by the following, which is selected from Prof. Parker's monograph: In *Balaniceps* we encounter a host of difficulties, both in the breast-bone and also in the furculum, although its general shape and proportions agree well with that of the gigantic storks. The costal processes are exactly like those of the adjutant, but the episternal process, which is distinct in the adjutant and long in the typical herons, is not differentiated in *Balaniceps*. In parrots, woodpeckers, and horn-bills, that emargination is absent which separates the episternum in most birds from the tip of the sternal keel. The same thing occurs in the *Balaniceps*; so that in this wader, as well as in those arboreal birds, the keel of the sternum projects some distance in front of the coracoid grooves. In most of the larger herons and in the storks, the end of the furculum has a gliding, synovial joint with the tip of the keel of the breast-bone; and this appears to be persistent even in very old birds. The same thing occurs in gannets and in cormorants. In several other birds the joint becomes obliterated in full age; for instance, in the cranes. But in the young *Balaniceps* not only is all trace of a joint gone, but the amount of ossification and the actual strength of this part are very strong; indeed, it is a seven-times-strengthened ankylosis. In some of the storks there are very small rudiments of a pair of sub-mesial emarginations besides the large lateral ones. In *Balaniceps*, however, these notches are nearly half an inch broad, while the outer notch is nine lines across.

In 1860 Mr. J. Petherick, then English consul for the Sudan, brought to the Zoological Gardens in London two shoe-bills, at which occasion he gave the following account of these birds, which at the time caused an intense interest in ornithological circles:—

"The birds here are seen in clusters of from a pair to perhaps one hundred together, mostly in the water, and, when disturbed, will fly low over its surface, and settle at no great distance; but if frightened or fired at, they rise in a flock high in the air, and, after hovering and wheeling around, will settle on the highest trees, and as long as their disturbers are near will not return to the water. Their food principally is fish and water-snakes, which they have been seen by my men to catch and devour. They will also feed on the intestines of dead animals, the carcasses of which they easily rip open with the strong hook of the upper bill. The breeding-time of the *Balaniceps* is the rainy season, during the months of July and August, and the spot chosen is in the reeds or high grass immediately on the water's edge, or on some small elevated and dry spots entirely surrounded by water." He continues to tell how he

failed in rearing young birds taken from the nest, but that he finally succeeded in hatching some eggs under hens. The veracity of Mr. Petherick has been doubted in regard to an alleged statement by him that the young shoe-bill "runs about in search of food immediately after it is hatched," — a feature which, if true, would be "one of the most extraordinary facts I have yet met with," as Mr. A. D. Bartlett puts it. I can find no such statement in Mr. Petherick's paper, however; and he only says that the young ones "ran about the premises of my camp," but nothing seems to indicate that they did so immediately after leaving the eggs. On the contrary, he says a little before that his men had robbed the nest "of both eggs and young," thereby indicating that the young ones remain in the nest for some time at least.

Finally it may be mentioned that observers fail to state whether it has a voice, only saying that they clatter the bills like storks. The flight is said to be like that of the marabou, but whether that means that it flies with outstretched neck I do not know. The eggs are covered with a chalky layer, as are those of the adjutants.

To complete the picture of "the father of the shoe," as it is named by the Arabs, we give the following description of the coloration: Bill yellow, blotched with dark brown; legs blackish; orbits pale yellow; general color dusky gray, with lighter edging; head, neck, and breast slaty, — the feathers of the latter with a dark stripe along the centre; rest of under surface much paler gray. As already stated, there is only one species known (*B. rex*), from the region of the White Nile, in eastern Africa.

Enough has been said under the head of the foregoing families as to the characters of the ARDEIDÆ, so that, in this place, it will only be necessary to mention that the family is the most numerous in species of those constituting the order. Herons are found all over the world, except in the coldest regions, each one of the primary zoogeographical divisions having a fair share, though North America is poorest and South America richest in that respect. We recognize three sub-families, — the bitterns, which have two pairs of powder-down patches only; the true herons, which have three; and the boat-bills, with four pairs. The powder-downs, though present also in some few birds belonging to other orders, are very characteristic of the herons, and many are the speculations which have been indulged in to find out their use to the birds. Some have thought that these patches of dense, clammy, yellowish down may be the cause of the herons being so singularly free of lice and vermin. It has also been hinted at that the old tale of a mysterious light emanating from the heron's bosom when fishing in the dark might have some foundation of fact, and that the powder-down might be the seat of such a light-emitting power.

We shall, in the following, give some extracts of a most excellent account by Mr. W. H. Hudson of the habits of some South American herons; the more since, as he correctly remarks, there is such a sameness in the way of life of these birds that most of what can be said about one species will equally well apply to others.

"Two interesting traits of the heron (and they have a necessary connection) are its tireless watchfulness and its insatiable voracity; for these characters have not, I think, been exaggerated even by the most sensational of ornithologists. In birds of other genera, repletion is invariably followed by a period of listless inactivity, during which no food is taken or required. But the heron digests his food so rapidly that, however much he devours, he is always ready to gorge again; consequently he is not benefited by what he eats, and appears in the same state of semi-starvation when food is abundant as in times of scarcity. An old naturalist has suggested as a reason for this that the heron, from its peculiar manner of taking its prey, requires fair weather to fish;

that during spells of bad weather, when it is compelled to suffer the pangs of famine inactive, it contracts a meagre consumptive habit of body which subsequent plenty cannot remove. A pretty theory; but it will not hold water: for in this region spells of bad weather are brief and infrequent; moreover, all other species that feed at the same table with the heron, from the little flitting *Ceryle* to the towering flamingo, become excessively fat at certain seasons, and are at all times so healthy and vigorous that, compared with them, the heron is but the ghost of a bird. In no extraneous circumstances, but in the organization of the bird itself, must be sought the cause of its anomalous condition. It does not appear to possess the fat-elaborating power; consequently no provision is made for a rainy day, and the misery of the bird consists in its perpetual, never-satisfied craving for food.

"The heron has but one attitude,—motionless watchfulness; so that, when not actually on the wing or taking the few desultory steps it occasionally ventures on, and in whatever situation it may be placed, the level ground, the summit of a tree, or in confinement, it is seen drawn up, motionless, and apparently apathetic. But when we remember that this is the bird's attitude during many hours of the night and day, when it stands still as a reed in the water; that in such a posture it sees every shy and swift creature that glances by it, and darts its weapon with unerring aim and lightning rapidity, and with such force that I have seen one drive its beak quite through the body of a fish very much too large for the bird to swallow, and cased in bony armor, it is impossible not to think that it is observant and keenly sensible of everything going on about it."

The herons are remarkable for their habits of perching and nesting on trees, notwithstanding their long neck and legs, and their 'gressorial' feet. But the length and the low position of the hind toe enables them to live an arboreal life, which seems so incongruous with the rest of their structure. We quote again from Mr. Hudson: "In the variegated heron (*Ardetta involucris*) [a bittern inhabiting southern South America], the least of the tribe, the perching faculty probably attains its greatest perfection, and is combined with locomotion in a unique and wonderful manner. This little heron frequents beds of reeds growing in rather deep water. Very seldom, and probably only accidentally, does it visit the land; and only when disturbed does it rise above the reeds, for its flight, unlike that of its congeners, is of the feeblest; but it lives exclusively amongst the reeds, that, smooth as a polished pipe-stem, rise vertically from water too deep for the bird to wade in. Yet the heron goes up to the summit or down to the surface, and moves freely and briskly about amongst them, and runs in a straight line through them almost as rapidly as a plover runs over the bare level ground.

"When driven from its haunt, the bird flies eighty or a hundred yards off, and drops again amongst the rushes; it is difficult to flush it a second time, but a third impossible. And a very curious circumstance is that it also seems quite impossible to find the bird in the spot where it finally settles. This I attributed to the slender figure it makes, and to the color of the plumage so closely resembling that of the withering yellow and spotted reeds always to be found amongst the green ones; but I did not know for many years that the bird possessed a marvellous instinct that made its peculiar conformation and imitative color far more advantageous than they could be of themselves.

"One day in November, 1870, when out shooting, I noticed a little heron stealing off quickly through a bed of rushes, thirty or forty yards from me; he was a foot or

so above the ground, and went so rapidly that he appeared to glide through the rushes without touching them. I fired, but afterwards ascertained that in my hurry I missed my aim. The bird, however, disappeared at the report; and thinking I had killed him, I went to the spot. It was a small isolated bed of rushes I had seen him in; the mud below and for some distance round was quite bare and hard, so that it would have been impossible for the bird to escape without being perceived; and yet, dead or alive, he was not to be found. After vainly searching and re-searching through the rushes for a quarter of an hour, I gave over the quest in great disgust and bewilderment, and, after reloading, was just turning to go, when, behold! there stood my heron as a reed, not more than eight inches from, and on a level with, my knees. He was perched, the body erect and the point of the tail touching the reed grasped by its feet; the long, slender, tapering neck was held stiff, straight, and vertically; and the head and beak, instead of being carried obliquely, were also pointing up. There was not, from the feet to the tip of the beak, a perceptible curve or inequality, but the whole was the figure (the exact counterpart) of a straight tapering rush; the loose plumage arranged to fill inequalities, the wings pressed into the hollow sides, made it impossible to see where the body ended and the neck began, or to distinguish head from neck or beak from head. This was, of course, a front view; and the entire under surface of the bird was thus displayed, all of a uniform dull yellow like that of a faded rush. I regarded the bird wonderingly for some time; but not the least motion did it make. I thought it was wounded or paralyzed with fear, and, placing my hand on the point of its beak, forced the head down till it touched the back; when I withdrew my hand, up flew the head, like a steel spring, to its first position. I repeated the experiment many times with the same result, the very eyes of the bird appearing all the time rigid and unwinking like those of a creature in a fit. What wonder that it is so difficult — almost impossible — to discover the bird in such an attitude! But how happened it that while repeatedly walking round the bird through the rushes I had not caught sight of the striped back and the broad dark-colored sides? I asked myself this question, and stepped round to get a side view, when, *mirabile dictu*, I could still see nothing but the rush-like front of the bird! His motions on the perch as he turned slowly or quickly round, still keeping the edge of the blade-like body before me, corresponded so exactly with my own that I almost doubted that I had not moved at all. No sooner had I seen the finishing part of this marvellous instinct of self-preservation (this last act making the whole entire), than such a degree of delight and admiration possessed me as I have never before experienced during my researches, much as I have conversed with wild animals in the wilderment, and many and perfect as are the instances of adaptation I have witnessed."

The uncouth 'booming' of the bittern is a mysterious sound of which most authors only speak with reservation and at second hand. Mudie's account of the "savage laughter that sounds as if the voices of a bull and a horse were combined" is often quoted, but he describes it as being produced by the flying bird. This "is evidently the offspring of his fine imagination," as Macgillivray correctly remarks, adding: "What a pleasant thing it is to be able to write copiously and with ease on a subject about which one knows nothing!" But we have better evidence that the English names of the European *Botaurus stellaris*, such as 'mire-drum,' 'bitter-bump,' 'bog-bumper,' only faintly express the roaring ability of this nocturnal performer. J. F. Naumann — a keener and trustworthier observer than whom was never born — asserts

that he has heard the bellowing and rumbling of the male bittern innumerable times, often throughout the whole night. He describes the sound as "*ü prumb*," the latter syllable much louder than the former, repeated several times. He sometimes heard, when he succeeded in getting close enough, a low sound precede the bellow, as if the surface of the water was beaten with a reed. The roar sounds, close by, *nearly* as strong as the bellow of an ox and may be heard, during a still night, at a distance of from three to four miles, according to circumstances. Naumann himself was never so



FIG. 85. — *Ardeomega goliath*, African giant-heron.

fortunate as to see the bird during the performance. Count Wodzicki, however, — also known as an excellent observer, — was more successful, and describes it in the following manner: "The artist was standing on both legs, with the body horizontal, and the bill in the water, and then a rumbling began, the water spouting about all the time. After a few sounds I heard the '*ü*' described by Naumann; the bird lifted the head, threw it backwards, put it again rapidly into the water, producing a roar that startled me." The sound of the American bittern (*B. lentiginosus*) is described as

somewhat different. Dr. Bachman, in a letter to Audubon, said that "their hoarse croakings, as if their throats were filled with water, were heard on every side." Others compare it with the sound produced by driving a stake in boggy soil, hence the name 'stake-driver.' Mr. Samuels renders this love-song of the male with *chunk-a-lunk-chunk*, *quank chunk-a-lunk-chunk*, "almost exactly resembling the stroke of a mallet on a stake."



FIG. 86. — *Heronia alba*, egret.

The cuts representing species of this family have been selected with the view of illustrating the chief forms under which the heron type appears. The first one is a characteristic reproduction of the African giant heron (*Ardeomega goliath*), the largest species of the tribe, with the back ashy, head and under side chestnut, and the ornamental plumes, except the crest of the head, whitish. It is nearly related to the true and typical herons, the interesting dichromatism of which we have mentioned in

the introduction (p. 7). The second cut shows very well the graceful plumes of the egrets (*Herodias*), a group characterized, besides, by slender but elegant proportions and the dazzling whiteness of the plumage. The species here figured is *H. alba*, of nearly cosmopolitan range, and represented on our continent by a slight race, *H. alba egretta*. Similarly white, but with the ornamental feathers of the head, breast, and back of a rusty isabella color, is the buff-backed cattle-egret (*Bubulcus ibis*), which has already been mentioned as the bird usually shown to the travelers in Egypt as



FIG. 87. — *Cochlearius cochlearius*, boat-bill.

the sacred ibis of the ancients. In its rather stout build, short neck, short and strong bill, it approaches the night-herons (*Nycticorax*), which, besides, are easily recognized by the extremely lengthened linear and compact webbed plumes on the occiput.

Two authors, each holding a leading position as ornithologist in their respective countries, in 1877 monographed the herons. One of them made the boat-bill (*Cochlearius*, or *Cunعروما*) a sub-genus under the genus *Nycticorax*, the other regarded it as constituting a separate family, equal in rank to the Ardeidæ. It will be seen that the

curious original of the accompanying wood-cut, the South American boat-bill (*C. cochlearius*) is the object of considerable diversity of opinion. To all external appearance, with the exception of the remarkable bill, which is greatly depressed and dilated laterally, the lateral outline much bowed, the boat-bill is a night-heron, that is, its general proportions, size, ornamental feathers, and coloration are those which characterize the night-herons. But while it resembles a night-heron, and originally may have sprung from the same stock, it is modified and specialized in so many ways and so important features, besides the bill and the consequent alteration of the skull, that we necessarily must regard Mr. Robert Ridgway's view as the most justifiable of the two mentioned above. As specializations additional to the strange conformation of the beak may be mentioned that the boat-bill has lost both the femoro-caudal muscle and the feather tufts on the oil gland, and that it has acquired a fourth pair of powder-down patches. Grading our groups on a somewhat different principle, however, we include the two species of boat-bills (a new species from Central America having been described this year by the last-named gentleman as *Cochlearius zeledoni*) in the sub-family Cochleariinae.

At first sight the *Cochlearius* seems to represent a pigmy *Balaniceps*, between the legs of which it can stand upright without bending its neck, and the view of their being closely related has also been urged by different authorities; but we cannot help thinking that Professor Reinhardt was right when he opposed Professor W. K. Parker's opinion to that effect, for, as Reinhardt remarks, even the outward likeness between the two bills is, on nearer inspection, by no means so great as would appear at first sight. The bill of *Cochlearius* is remarkably flattened, and not so much calculated for great strength as for great roominess; and this is still more increased by the naked dilatable skin between the branches of the lower jaw, which can be distended into a complete pouch or bag hanging down as far as the throat.

ORDER X.—STEGANOPODES.

Notwithstanding the shortness of the legs and the 'Steganopodous' character of the toes,—that is, the connection of all four toes by membranes,—the birds of the present order are unquestionably nearly related to the *Herodii*. Like these, they are desmognathous, and lack basipterygoid processes; "but the inner edges of the palatine bones unite for a much greater distance behind the posterior nasal aperture, and a median ridge is sent down from the line of junction of the palatines." Authors have been equally unanimous in asserting the great homogeneity of the group, until Professor St. G. Mivart, in 1877, in his valuable memoir, "On the Axial Skeleton of the *Pelecanidae*," raised doubts as to the propriety of referring the tropic-birds and frigate-birds to the Steganopodes, though it is not quite correct to say that, "according to him, the tropic-birds are wrongly placed with this order." Here are his own words: "Besides [*Pelecanus*, *Sula*, *Phalacrocorax*, and *Plotus*], the two genera *Fregata* and *Phaethon* are usually classed with them to contribute to the group of the Steganopodes. But, from the point of view here adopted (that of the posterian part of the axial skeleton only), I have found it impossible to detect characters which seem to me good and sufficient to unite such Steganopodal groups together, and at the same time divide them off from other forms." It appears, however, that in the above-mentioned structure of the palate and the feet, which Mivart, together with the rest of the cranium and the extremities, intentionally excluded from his comparison, there are characters

"good and sufficient to unite the Steganopodal group together, and at the same time mark it off from all other groups of birds."

Another thing is, that Mivart has shown that the four supergenera, included in brackets above, are more intimately related *inter se* than to the two other ones. These two, on the other hand, chiefly agree to differ from the former four in negative points, and hence their exclusion from these does not indicate any particular mutual intimacy. On the contrary, the tropic-birds and the frigate-birds are as different between themselves as each of them is from the rest. We therefore propose to dismember the order in three superfamilies, Pelecanoideæ, Fregatoideæ, and Phaëthontoideæ, an arrangement which is essentially the same as that proposed by Professor Brandt forty years ago.

This arrangement needs a short explanation. There will be found, later on, a few more details concerning the peculiar arrangement of the neck vertebrae of the first-mentioned superfamily. In the last two the neck is normal, and, consequently, they have not developed as off-shots from the stem of the Pelecanoideæ. The extreme specialization of *Fregata* in regard to the thigh muscles, A+, can, therefore, not be derived from the Pelecanoideæ, notwithstanding that the myological formula of the latter, AX+, otherwise would allow of such an interpretation. On the other hand, it is even more plain that the myological formula, AXY+, of the tropic-bird cannot directly or indirectly be derived from the pelicans or the frigate bird, nor, indeed, the latter two from the former. We are, consequently, compelled to assume a common ancestor with normal arrangement of the cervical vertebrae and a myological formula consisting of, at least, AXY+.

We have occasionally had opportunity to hear people ridicule the stress laid upon the presence or absence of such a trifling thing as a small muscle of the leg seems to be. In some instances the presence or absence, considered alone, throws no light upon the manner in which two forms have developed, and in other cases it seems to the superficial observer to have no systematic importance, — for instance, when a species has a certain muscle which is wanting in a closely allied form of the same genus; but even then it is of considerable interest, since it shows that the latter has developed out of the former, and not *vice versa*. The above example, however, derived from the present order, should convince even the most superficial observer that there are cases in which these tiny muscular slips play a most important role.

We have discussed the distinctness of the three groups here proposed only on the basis of a few characters, since want of space prevents us from going further into details; but in order to show that the differences are rather deep-rooted, it will be sufficient to remind one of the fact that they are apparently not due to direct teleological causes. In all three groups there are excellent flyers, with long wings; but one of them also comprises rather short-winged divers. Similarity in habits and manner of life may account for the external and superficial resemblance between a gannet and a tropic-bird, but we know of no difference in their habits sufficient to explain the anatomical diversities alluded to above.

In addition to the characters common to all the members of the group, as given at the beginning of this chapter, the double condition of the pectoral muscle is here described in Professor Garrod's words: —

"The great pectoral muscle is composed of two independent layers, — a superficial large one, arising from the inferior border of the sternum, its carina, and from the outer border of the furcula; and a deep one from the upper two thirds of the deeper

part of the carina, superficial to the *pectoralis secundus*, and from the symphysial half of the outer border of the furcula. The superficial layer is inserted by a broad linear attachment to the pectoral ridge of the humerus, whilst the deeper layer ends in a rounded tendon." According to Garrod, this arrangement is exactly alike in *Plotus*, *Phaëthon*, *Pelecanus*, *Sula*, and also in *Phalacrocorax*, though not so easily recognized in the latter. The birds of other orders which show a similar condition, are the American vultures, the storks, and the petrels.

Professor Huxley, in enumerating the characters of the 'Dyspöromorphæ,' as he styled this order, indicates that the phalanges of the anterior toes decrease in length from the basal to the penultimate. A re-examination of the group has convinced me that this is not correct. It will be seen from the figure, further on, of the bones of the foot of *Fregata*, that the ratio of the phalanges is quite different, — the basal ones of the second and third toes being shorter than the next ones. A similar ratio is also found in the gannets, especially the smaller species, and likewise in the darters.

In common with the frigate-birds, the PHAËTHONTOIDEÆ have a comparatively large head, mounted on a short and thick neck, consisting of fewer and normally articulated vertebræ. The wings are long and pointed, the tail cuneate, with the two middle feathers extremely lengthened. The feet are rather small, but the webs are ample; they are totipalmate, like all the members of the order, — that is, even the first toe is connected with the next one by a membrane; and in this particular group it is short, and turned nearly forwards. Another peculiarity of the hind toe is that it articulates with the metatarsus considerably above the level of the other toes, herein differing from the other members of the order. The claw of the third toe is not pectinated. In having an undivided sheath, without any groove or detached pieces, the bill resembles that of a tern, but the edges are serrated. Like the terns, the tropic-birds have pervious nostrils, therein differing considerably from the other members of the order, in some of which the external openings of the nares are absolutely closed in the adult birds; but in contradistinction to the terns and gulls, the tropic-birds are strongly holorhinal. Additional osteological characters will be mentioned under the descriptions of the other groups, though we may remark here that the hind border of the breast-bone has two notches, and, consequently, two lateral processes on each side, somewhat similar to the condition in the gulls.

The myological peculiarities are described thus by Garrod: "*Phaëthon* possesses the femoro-caudal (small), the semitendinosus (strong), and the accessory semitendinosus; the ambiens, the accessory femoro-caudal, and the postacetabular portion of the tensor fasciæ are absent. In this bird the biceps cruris is inserted into the fibula-head directly, without passing through a loop."

Pterylographically there is only little difference between the present super-family and the Pelecanoidæ, but the structure of the feathers is different, they being more elastic and more curved, rather resembling, according to Nitzsch, those of the geese. The skin is pneumatic, similar to that of the gannets, and each oil-gland has three openings.

The tropic-birds — an appropriate name for these intertropical birds — are also called 'boatswains,' for the same reason as the jagers, namely the extremely elongated middle tail-feathers. In their general aspect, the white color of the body, and the red or yellow bills, size, etc., they closely imitate the gulls or terns; and many travelers have described their habits as similar to the latter, but the resemblance seems to be very slight and very superficial. The tropic-birds are very oceanic, and are often

met with many hundreds of miles from any shore. Their flight is described by Professor Newton as not resembling that of any sea-bird with which he is acquainted, its chief peculiarity consisting in the regular and rather rapid strokes of the wing, without any intermission, as far as he could see; and Mr. C. B. Cory expressly says that it "does not at all resemble the long, easy movements of the gulls, but is hurried and rapid, more resembling that of a duck." They usually breed in cracks of the cliffs, on the ledges of rocks, or under overhanging boulders, but build no nest. The single egg, rather large and of a reddish-brown color, with fine markings, is said to be good eating, and in some localities large quantities are gathered for food; hence the name



FIG. 88. — *Phaethon athereus*, red-billed tropic-bird.

'egg-bird' in the Bahamas. Also the long and stiff central tail-feathers are collected, especially those of *Phaëthon rubricauda*, in which they are red, in beautiful contrast to the rest of the plumage. Mr. Edward Newton describes the visit to a breeding-place of this species on Round Island, a small islet close by Mauritius, as follows: "Here the red-tailed tropic-bird breeds in very large numbers. They are the tamest birds I ever saw, and do not know what fear is. They never attempt to leave their single egg or nestling at one's approach, but merely stick out their feathers and scream, pecking at one's legs with their beaks. It is the fashion on the island for visitors to remove the old bird from its egg by a slight shove, and then placing the foot gently

on its head, to draw out the long tail-feathers. It resents this insult by screaming and snapping, but never tries to escape by flying or shuffling along the ground; in fact, like all birds which have their legs placed so far behind, they cannot rise off a flat surface, but require a drop of a few feet to give them an impetus." Where rocks are wanting, however, the tropic-bird breeds in trees. The same gentleman, during a mountain ascent on one of the Seychelles, observed a yellow-billed tropic-bird (*P. flavirostris*) enter a hole in the stump of a dead tree. "On returning," he says, "I made for it. After a scramble over dead wood and granite boulders, I got to it. The hole was about fifteen feet from the ground, and my man soon ascended, not, however, without fears on my part that the rotten old stem would come down with his weight. Unfortunately there was only a young bird inside it. This I took home and endeavored to rear, but it only lived four days." The young is covered with pure white down, and consequently is very unlike the downy young of the Laridæ. The chick, like that of all the members of the order, is reared in the nest, or rather on the spot where the egg was hatched, until able to fly.

Only three species are known, — the two above mentioned, and the red-billed, white-tailed *P. athereus*, which is the species represented in our wood-cut.

In Fig. 89 is shown one of the more obvious characters of the FREGATOIDEÆ, namely, the remarkably short tarsus, the shortness and breadth of which is absolutely unique amongst the Euornithes. It is only equalled by the corresponding bone of the penguins, in which, however, the three component metatarsals are nearly separated, and equally well developed. On the whole, the foot of the frigate-bird is short, and abnormally developed, for the "webs" are so deeply excised that they hardly deserve their name, and the tarsus is feathered to the legs and feathered to the toes, — a very extraordinary feature in a "water-bird," it being, in fact, the only one among all the birds so designated that exhibits this character. The abnormal ratio of the phalanges of the middle toe has already been mentioned.

The wings are hardly less remarkable, since the cubitus is longer than the upper arm bone by one third of its length; and as the humerus itself is very long, the stretch of the wings becomes quite excessive in proportion to the size of the body. In regard to the breast-bone we remark that the hind border is described as truncate, without any notches or lateral processes. Peculiar to *Fregata* is also the fact that there is no interval between the lumbar and caudal vertebræ, as the transverse processes are continuously developed throughout these vertebræ. As to the pelvis, it may be remarked that the ilia do not meet together medianly in front of the acetabula at all, as they do in both the other super-families. The caudal vertebræ have very strong transverse processes, and the external tail is long and very forked. In many other external characters the frigate-birds show affinities to the cormorants; for instance, in the shape of the bill, which is composed of several pieces separated by grooves, ending in a strongly-hooked nail, in the naked gular pouch, and also in the pectination of the claw of the third toe. The pterylosis approaches that of the cormorants, but is peculiar on account of the remarkable sparse arrangement of the contour feathers.



FIG. 89. — Leg bones of *Fregata aquila*, from the knee. *tb*, tibia; *mts*, tarso-metatarsus.

On the whole, the cormorants seem to be the nearest allies, but, as already noted, the differences are many and important. In regard to alleged relationship to members of other orders, it may suffice to mention that there are peculiarities in the skeleton and the myology which have been interpreted as indicating affinity to the petrels, — theories which only future investigations will be able to decide upon.

Only one family, FREGATIDÆ, and one genus, *Fregata*, consisting of two species, compose the super-family, which, like the foregoing one, is peculiar to the inter-tropical seas.

The description of the extreme length of the wings of the ‘man-of-war hawk,’ as they are often called, indicates the enormous power of flight of the ‘hurricane bird,’ another name by which they are known to the sailors, and Audubon’s graphical account is only one of the many enthusiastic descriptions:—

“The frigate-pelican is possessed of a power of flight which I conceive superior to that of perhaps any other bird. However swiftly the Cayenne tern, the smaller gulls, or the jaeger move on wing, it seems a matter of mere sport to it to overtake any of them. The goshawk, the peregrine, and the gyrfalcon, which I conceive to be the swiftest of our hawks, are obliged to pursue their victim, should it be a green-winged teal or passenger-pigeon, at times for half a mile, at the highest pitch of their speed, before they can secure them. The bird of which I speak comes from on high with the velocity of a meteor, and on nearing the object of its pursuit, which its keen eye has spied while fishing at a distance, darts on either side to cut off all retreat, and with open bill forces it to drop or disgorge the fish which it has just caught. See him now! Yonder, over the waves, leaps the brilliant dolphin, as he pursues the flying-fishes, which he expects to seize the moment they drop into the water. The frigate-bird, who has marked them, closes his wings, dives towards them, and, now ascending, holds one of the tiny things across his bill. Already fifty yards above the sea, he spies a porpoise in full chase, launches towards the spot, and in passing seizes the mullet that has escaped from its dreaded foe. I observed a frigate-pelican that had forced a Cayenne tern, yet in sight, to drop a fish which the broad-winged warrior had seized as it fell. This fish was rather large for the tern, and might probably be about eight inches in length. The frigate-pelican mounted with it across his bill about a hundred yards, and then, tossing it up, caught it as it fell, but not in the proper manner. He therefore dropped it, but before it had fallen many yards caught it again. Still it was not in a good position, the weight of the head, it seemed, having prevented the bird from seizing it by that part. A second time the fish was thrown upward, and now, at last, was received in a convenient position (that is, with its head downwards), and immediately swallowed.”

Dr. Bryant visited several breeding-places of *F. aquila*, in the Bahamas. In one place the nests were on the bare rock, and closely grouped together; in another, they were built upon the mangroves, while on the Seal Island they were placed on the tops of prickly-pear. Mr. G. C. Taylor describes his visit to a rookery on a small islet on the Pacific coast of Honduras as follows:—

“At a distance the most conspicuous object was a numerous flight of frigate-birds soaring over the island. As we approached, large white patches, caused by the droppings of the birds, became visible. The whole island was appropriated by the frigate-birds. Nearly every tree and bush, both high and low, was covered with birds and their nests. The latter were mostly composed of a few sticks laid crossways, hardly as much in quantity as in the nest of the ring-dove (*Columba palumbus*). Each nest

contained a single egg, about the size of a hen's-egg, and of a chalky whiteness. Although the nests were upon low bushes, still they were placed just too high for one to reach the eggs without climbing. The difficulty was to get the birds off their nests. Shouting had little or no effect; and even the report of a gun would only rouse a few, who would frequently settle again on the bushes. I threw some stones among them, without producing much result, and even tried to poke them off their seats with my gun; but they merely snapped their beaks at me in retaliation."

According to Professor Mivart, the PELECANOIDÆ differ from the two foregoing super-families in possessing a greater number of cervical and cervico-dorsal vertebrae, viz., seventeen to twenty, against fifteen only in the latter. But the most marked feature is, perhaps, the peculiarity in the eighth or ninth cervical vertebra, by which it is angularly articulated with the vertebra in front and behind. By this arrangement is caused the characteristic kink in the neck of these birds, which may be seen plainly in the wood-cuts representing the darter and the cormorant. Indeed, it is literally impossible for these birds to carry their neck straight. This angular condition of the neck is most developed in the darters; in a less marked degree in the cormorants, and still less so in the gannets and pelicans, though observable in all.

Other distinctive characters of the skeleton as compared with the tropic-birds and frigate-birds are the presence of one to three distinct sacral vertebrae, the moderate size of the lateral acetabular fossa, and the presence of fully or nearly completed hæmal arches to some of the vertebrae; "but in *Fregata* and *Phaëthon*, not only are there none, but no tendency to form hæmal arches is exhibited." The hind margin of the breast-bone has only one lateral process on each side.

We recognize four groups of equal rank, since it seems "difficult to unite together any two of them to the exclusion of the others." Of these four families Professor Mivart thinks that the darters, as the most exceptional and differentiated type, should form one end of the series, to be begun with the pelicans, which in some points, at least, appears the least differentiated and most generalized form.

Accordingly we commence with the PELECANIDÆ, the pelicans proper, the appearance of which, with the enormous pouch suspended between the branches of the lower jaw, is so familiar to everybody that we feel at liberty to dispense with a general description,—the more so, as the accompanying cut will revive in the imagination of our reader the picture of this grotesque bird if some details should have faded out of the memory.

In one anatomical feature, at least, the pelicans stand quite isolated, and Huxley considered it to be so important that upon it he based a subdivision of the order into two groups, one to contain the pelicans, the other embracing all the other 'Dysporomorphæ.' Here is his description of the peculiarity: "In the Pelecanidæ the inferior edge of the ossified interorbital septum rises rapidly forward, so as to leave a space at the base of the skull, which is filled by a triangular crest formed by the union of the greatly developed ascending processes of the palatines."

One external character only shall here be mentioned; viz., that the tail consists of twenty-four rather soft rectrices, a feature well worth noting, since in all the other families are the tail feathers very stiff, and their maximum number sixteen.

Pelicans are found in the New World as well as in the eastern hemisphere, but they are confined to the tropics, and the warmer portions of the temperate regions, though a single species or two may breed in more northern localities where the summers are warm.

Such a species is our North American white pelican (*Pelecanus erythrorhynchos*), formerly confounded with the species figured. A very distinctive and remarkable feature, however, is the irregular protuberance on the culmen, which is equally developed in both sexes. Mr. Robert Ridgway, who, in 1868, during a visit to the island in Pyramid Lake, Nevada, discovered the regular shedding of this horn, or 'centre-



FIG. 90. — *Pelecanus onocrotalus*, European white-pelican.

board,' as it was appropriately called by the inhabitants of the neighborhood, describes it as follows: "The maxillary excrecence varies greatly both in size and shape. Frequently it consists of a single piece, nearly as high as long, its vertical outlines almost parallel, and the upper outline quite regularly convex, the largest specimen seen being about three inches high by as many in length. More frequently, however, it is very irregular in shape, usually less elevated, and not infrequently with ragged ante-

rior, or even posterior, continuations. This excrescence, which is assumed gradually in the spring, reaches its perfect development in the pairing season, and is dropped before or soon after the young are hatched; simultaneously with the shedding of this appendage, the nuchal crest falls off, and in its place a patch of short brownish-gray feathers appears; this disappears with the fall moult, when the occiput is entirely unadorned, there being neither crest nor colored patch."

Mr. Ridgway first made a visit to the island in July, 1867. Thousands of pelicans, slumbering on the beach, were startled, when he landed with his party in the evening, "and as they rose into the air the noise caused by their confusion was so great that we could scarcely hear one another's voices. Our blankets were spread upon the higher ground some distance from the boat, in order to avoid the offensive smell of the roosting-ground. In the morning, when we awoke, the whole beach about fifty yards from us was covered with a dense crowd of these gigantic snow-white creatures, who scarcely heeded us as we arose; as we approached them, however, they pushed one another awkwardly into the water, or rose heavily and confusedly from the ground, and, flying some distance out upon the lake, alighted on the water. The majority of the flock remained upon the water only a short time, when they arose and flew—divided into battalions—passing over us, each turning its head and looking down upon us as it went by." At that time none of the many thousands possessed the appendage. Mr. Ridgway repaired to the lake again in May of the following year, when he found the pelicans in pairs, and provided with the "conspicuous prominence on the top of the upper mandible, known among the white people of the neighborhood as the 'centre-board,' so called from the fancied resemblance to the centre-board of a sail-boat. This ornament was observable on quite a large proportion of the birds, and was conspicuous at a considerable distance. At this season both sexes were highly colored, the naked soft skin of the face and the feet being fiery orange red, or almost blood-red, instead of pale ashy straw yellow, as in all, both old and young, in August.

"In viewing the northern shore from an eminence, it was noticed that the narrow point, which extended some hundred yards or more beyond the main beach, was literally covered with a dense body of pelicans, apparently merely resting, as many of them were standing; however, upon proceeding to the spot, it was found that the ground was covered with nests, upon which the females had been sitting, each one attended by her mate, who stood by her side. The nests occupied fully one half the surface, and consisted of mere heaps of gravel and sand raked into a pile about six or eight inches high, and probably twenty wide on the top, which was only slightly hollowed. In each nest we found one egg, and never more.

"Soon the number of birds distinguished by the 'centre-board' daily decreased, while, to account for this phenomenon, a corresponding number of cast-off ones was found upon the ground. Some of these loosened ornaments had been but recently dropped, as was plainly shown by their freshness, while others, which had been cast for some time, were dry and warped by the sun. Towards the last of the month no birds possessing this excrescence were to be seen, but the appendages themselves were scattered so numerously over the ground that a bushel could have been gathered in a short time, though upon our first arrival on the island not one was to be seen."

Mr. D. G. Elliot describes them in their winter haunts as follows: "On the southern coast of the United States they are very abundant, and I have witnessed them in winter on the sea-beach of Florida, standing close together in long rows of many hun-

dreds of individuals, enjoying a siesta after fishing. This species does not plunge into the water after its prey, as is the custom of its relative, the *P. fuscus*, but swims along, beating the surface of the water with its wings, and scooping up great numbers of fish at once. When raising the bill from the water, the point is held downwards until all the water has been allowed to run out from the sac, and then the small fish contained in the skinny bag are devoured at leisure. Sometimes so many fish, or such large ones, are obtained that the sac hangs down nearly to the ground, it is so very elastic; while at other times, when empty, it is drawn up between the crura of the lower mandible. When on the wing, the head is drawn in close to the shoulders, the webbed feet extended behind. I have never heard them utter any sound as they thus proceeded."

About a dozen species or forms of pelicans are known. All of them have the region between the eye and the bill bare of feathers, except the Australian species, the speckled pelican (*P. conspicillatus*), which has only a naked ring round the eyes, like spectacles (*conspicilla*), — hence the names.

Next come the gannets or boobies, the *SULIDE*, the typical species of which is beautifully figured in the accompanying cut. We remark at once that the bill terminates rather pointedly, the 'nail' only being slightly bent, and not hooked over the tip of the lower mandible, as in both pelicans and cormorants. We have already mentioned the abnormal ratio of the phalanges of the toes. The wings are long and strong, and the birds are consequently excellent flyers, which secure their prey, consisting of fishes, by plunging headlong into the water, with a velocity that makes the spray rise several feet. In order to offer the minimum of opposition in the bird's diving progress, the sternal apparatus has been peculiarly modified. The breast-bone itself is unusually long for a bird of this order, being nearly twice as long as it is broad, and the coracoids, as pointed out by John Flower, are articulated in a direction nearly parallel with the axis of the breast-bone, and not, as in most birds, at nearly right angles to it, an arrangement differing widely from that in the cormorants. Like the other great flyers of the order, the gannets possess a "system of subcutaneous air-cells which pervade almost the whole surface of the body, and are capable of voluntary inflation or exhaustion," already referred to while describing a similar peculiarity in the screamers.

'Sula' is an old Norse word, meaning a swallow, and the gannet is, in the Scandinavian languages, known as the 'hav-sula,' or sea-swallow, probably because of its powerful flight. One of the popular English names of the bird, — the 'solan goose,' — is evidently related, and probably directly derived from the Norse word, and would consequently mean 'swallow-goose.' Other names bestowed upon these birds are 'gentleman,' or 'Jan van Gent.' Macgillivray describes its flight thus: "In launching from the cliffs, they frequently utter a single plaintive cry, perform a curve having its concavity upwards, then shake the tail, frequently the whole plumage, draw the feet backwards, placing them close under the tail on each side, and cover them with the feathers. In flying, the body, tail, neck, and bill are nearly in a straight line; the wings extended, and never brought close to the body, and they move by regular flappings, alternating with regular sailings." It is interesting to remark that they fly with outstretched necks, as do the cormorants, thus presenting a similar difference from the pelicans, as do the storks and ibises from the herons.

The food of the gannet consists chiefly of herrings, and having, like the pelicans, a very dilatable œsophagus, it is capable of swallowing fish of considerable size.

Being without a gular pouch, it feeds its young by disgorging, and Macgillivray assures us that it never carries fish to the rock where it breeds, in its bill.

The solan goose breeds in large colonies on small islands and rocks in the North Atlantic Ocean; for instance, on the Bass Rock in Scotland, hence the specific name. This rookery has been described and depicted so often and elaborately by everybody who ever wrote of the natural history of this bird, that it would be trivial to repeat



FIG. 91. — *Sula bassana*, gannet.

it here. Suffice it to say that Macgillivray, in 1831, estimated their number on that celebrated rock to be about twenty thousand, and that Dr. Cunningham, thirty-one years afterwards, found no decrease. Much larger is the colony on Gannet Rock, in the Gulf of Saint Lawrence; for Dr. Bryant, in describing a visit to that island, says: "Their number on the summit could be very easily and accurately determined by measuring the surface occupied by them; by a rough computation I made it to be about fifty thousand pairs, and probably half as many more breed on the remaining

portion of the rock, and on the Little Bird." The nest is usually built of grass or sea-weeds, which the birds tear off with their sharp beaks, and a single egg of a chalky whiteness, but usually stained and soiled, is deposited, from which is hatched a naked slaty-blue chick, soon to be covered with snow-white down. The adults are white, head and neck above washed with buff, bill bluish-gray, feet slate-color with light green stripes, indicating the course of the tendons; eye yellow. The immature birds are dusky, speckled all over with white spots.

A few allied species inhabit the tropical seas of the eastern hemisphere, and a group of smaller, more or less dusky-colored gannets are entirely inter-tropical. In general habits they differ but little from the typical species, and altogether there are at present hardly ten different forms. The fact that fossil *Sulidae* have been found in France in miocene fresh-water deposits indicates, however, that this family formerly was wider distributed and richer in forms. A miocene *Sula* is also known from North Carolina.

The two following families are probably more closely related *inter se* than they are to any of the foregoing. The following are a few characters which the cormorants and the darters have in common, and in which they differ from pelicans and gannets: They have twenty vertebrae in the neck, against seventeen to eighteen; the ninth vertebra is the first one pressed back preaxially, and not the eighth; the twentieth to twenty-fourth vertebrae in the cormorants, and the twenty-second to twenty-fifth vertebrae in the darters, are opisthocœlous, while none have that character in the pelicans and gannets; the latter possess a spinal feather-space, which the former have not, but these have an occipital style unknown in the others. This occipital style is a triangular, elongated bone, articulating with the tubercle on the middle of the upper edge of the occipital bone. The object of this process is to afford surface for the insertion of "the superficial temporal muscles meeting behind the skull along the median raphe, which becomes ossified to form the above-mentioned style in the adult bird." A myological feature, which is not shared by the two foregoing families, is that the biceps muscle of the arm sends a fleshy slip to the middle of the patagial tendon of the *tensor patagii longus*. Finally may be mentioned the very backward position of the hind limbs, which force the cormorants and darters to carry their body more erect than the other members of the order.

The cormorants, PHALACROCORACIDÆ, are readily distinguished from other Steganopods by the combination of a strongly hooked bill, in shape and structure like that of the frigate-bird,—long neck, short wings, and rather long, rounded tail. The head is often crested, and head and neck frequently adorned with thin filamentous plumes, which are assumed towards the pairing season, and disappear after the breeding.

We regard this family as the central one of the order, hence the negative nature of the characters including the anatomical features, the status of which is best found by consulting the diagnoses of the other families. Here shall only be mentioned the peculiarity of the ambiens muscle in passing through the substance of the large triangular patella in a bony canal.

The cormorants form a very homogeneous group of nearly forty existing forms, and even the tertiary cormorants seem to be very closely allied to the typical species of the present day, indicating that the group has assumed its peculiarities at quite a distant period.

On account of this uniformity, nobody who ever saw a cormorant will be in

doubt of the true position of any of the members he might come across, and consequently the accompanying figure, although representing a now probably extinct species, will serve as well for illustrating the structure of the existing birds. These, which are distributed all over the globe, except the very Arctic regions, are generally of a blackish color, with more or less bronzy reflections, and the naked face usually brightly colored, but some species, especially from the Australian seas, have the whole under surface white. New Zealand is especially rich in shags, as these birds are also called, having not less than thirteen species, amongst these the curiously colored spotted shag (*Phalacrocorax punctatus*) peculiar to that colony; it is beautifully brownish ash above, each feather with a velvety black spot at the end; the under side is leaden gray; head and neck blackish, with a broad white band along the sides; the legs are flesh-colored; the eyes, like those of most cormorants, green.

The cormorants are very sociable, and are usually found in great flocks all the year round. Another feature of their character is their inquisitiveness. I well remember that afternoon when we left Copper Island, steering for the island where the celebrated navigator, Bering, died after having been shipwrecked. I stood with Captain Sandmann on the deck when we were doubling the northwest cape of the former island. Flock after flock of violet-green shags (*P. pelagicus*) came up to the steamer, veered round, then passed over the vessel behind the smokestack, bending and stretching their long necks in the utmost curiosity, and, as if they had not seen all they wanted, some of them would return a second time. This lasted as long as we could see the cape. As I expressed my surprise at the enormous number, the captain replied that the sight now was nothing against what it used to be. The shags were, until a few years previous, so abundant at this point that they served as a conspicuous landmark, which could be relied upon even in the thickest fog. But one winter the majority of them died by an epidemic disease. The dead corpses covered the beaches all around the islands, and the natives were much agitated by the prospect of these birds becoming entirely extinct, since they form their main source of fresh meat during the long winter. A few survived, however, and their number increased yearly.

This incident recalls the fate that has befallen the spectacled, or Pallas's, cormorant (*P. perspicillatus*), which, not more than thirty years ago, inhabited the neighboring Bering Island, while now not a single locality is known where this large and conspicuous shag may still survive; in fact there are no authentic records of it having ever been found outside of the island named. Two of the specimens in museums are said to have come from Sitka, but they were not collected there, and are probably from Bering Island. When, in 1882-'83, I visited that locality, I made all possible efforts to obtain specimens, but all I could learn of it was that the last one was killed about a generation ago. We have therefore taken pains to secure a most excellent illustration of one of the rarest birds in collections. For, while we know of more than seventy specimens of the great auk, and thirty of the Labrador duck, hardly more than three spectacled cormorants exist in European museums, and none in this country. It would be well worth the while to make a thorough search all over the uninhabited rocky islets of the Aleutian chain, as a few specimens, should they still exist in some out-of-the-way place, would amply repay the trouble and expense.

That the Chinese fishermen trained cormorants to catch fish for them was known long ago. Subsequently the stories were more or less discredited. We shall therefore transcribe the following authentic account from the 'Special Catalogue of the Ningpo Collection in the International Fishery-Exhibition at Berlin:—

"Many are the ways used in this province for catching fish of all kinds in the rivers, lakes, and canals; but none of them are more curious than the cormorant-fishing, which may be seen everywhere about Ningpo. Certain places are noted for the excellence of the birds which are bred and trained there: amongst these we may name Fêngshan and Shaohsing.

"The most celebrated place, however, is a small town called Tanghsichên, fifty li northwest of Hangchow, the people of which are currently believed to possess a secret in cormorant-rearing which gives them special success.

"The cormorant's book name is *Lu tzu*, and the common name is *Yu ying* ('fish-hawk'), or *Yü ya* ('fish-crow').

"The females lay early from three to nine eggs, in the first and eighth moons. The color of the eggs is green, but it is much covered with white chalk; their size is that of ducks' eggs. The white inside is slightly green, and the eggs are never eaten on account of their strong flavor.

"The eggs of the first season (first moon) are the only ones retained for hatching. Towards the beginning of the second moon they are given to the hens to hatch, as the female cormorant is a careless mother. The young break their shell after a month's incubation. When new-born they cannot stand on their legs, and are very sensitive to cold. They are therefore taken away from the hen, placed in baskets filled with cotton wool, and kept in a warm place. The eggs of the second season are not used, the weather be-



FIG. 92. — *Phalacrocorax perspicillatus*, Pallas' cormorant.

ing too cold; they are given away to children and beggars.

"The young birds are at first fed with a mixture, in equal parts, of beancurd and raw eel's flesh cut fine. If eels are not procurable, the flesh of the *Ilei yü* (*Ophiocephalus niger*) is used instead, in the form of small pills. At the end of a month the down begins to be covered by the larger feathers, and the quantity of fish-flesh given to them is increased, while that of beancurd is reduced. A second month elapses, and the young birds, having grown to double their original size, are fit for the market; a male fetches \$1 or \$2, and a female half as much.

"The birds are now fed with young fish thrown to them. When they have attained their full size, a string is tied to one leg, the other end of it being fastened to

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Pandion haliaëtus, fish-hawk, osprey.





Cereopsis nove-hollandiae, Cape Barren goose.

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CRANES.

Tetrapteryx virgo, demoiselle ; *Balenica paroniu*, crown'd-crane ; *Grus grus*, common European crane.

the bank of a pond or canal. They are then made to go into the water, the trainer whistling a peculiar call and using a bamboo to force them. Small fish are thrown to them, upon which they pounce greedily, as they have been kept on short allowance of food. They are now called back by a different whistle-call, and forced to obey by means of the string; as they reach the shore more fish is given them. This teaching having been gone through daily for a month, another four or five weeks are spent in training the birds from a boat; at the end of this period the string is generally dispensed with. When old and well-trained cormorants are made to accompany the young ones, the time required in training is reduced to one half. Birds not properly trained after all the trouble thus taken are pronounced stupid and not fit for use.

"The teaching being completed, the cormorants are fed sparingly every morning with fish. A small ring of hemp is tied around their necks to prevent them swallowing large fish; and they are taken on board the small punt called 'cormorant-boat,' to the number of ten or twelve. They are now as docile as dogs, and sit perched on the side of the boat until they are sent into the water by a mere whistle from their master. They dive after fish, and bring their prizes to the boat, firmly held in their hooked beaks. When a fish is too large for one bird, three or more join their forces and capture it together. Sometimes the fisherman signals them to dive by striking the water with a long bamboo. If any cormorant is inclined to be disobedient, his legs are connected by a short piece of string; this forms a loop, by which the bird may at any moment be brought on board, *volens volens*, with a long bamboo hook.

"After fishing two or three hours the birds are allowed to come on board and rest. At the end of the day the hempen ring is loosened or removed altogether, and they are either allowed to fish for themselves, or are fed by the hand of their master. Seizing the birds one after another by the upper mandible, the fisherman thrusts into their throats a handful of small fish and a ball of beancurd as large as his fist, the ingurgitation of which he helps with the other hand by stroking the neck of the bird, who seems to enjoy it, as he promptly returns for a second supply. The entire scene is most ludicrous. At night the birds are brought home and caged. A cormorant holds out for five years, at the end of which time these birds lose their feathers and soon after die. The females, being weaker than the males, only catch small fish, hence their lower value. Very good birds reach a value of Fls. 10 a pair, a well-trained male being worth \$6 or \$7. The females lay when one year old."

No one who is familiar with the look of the cormorant can fail to appreciate the general resemblance of the darter as this bird is depicted in the accompanying cut, not only in the way it sits up, but also in several features of form and structure. On the whole it makes the impression of an exaggerated cormorant. The small head is still smaller, the neck still longer and narrower, the 'kink' still more angular, the tail still more elongated. The bill is more after the fashion of a heron than a cormorant, being straight, compressed, pointed, without nail, lateral groove, but serrated along the cutting edges. However, were it not for the many important anatomical features, the *ANHINGIDÆ* would have to be merged into the family of the cormorants. Having several times alluded to the osteological characters of the darters, the only thing to be mentioned here is, that the occipital style in *Anhinga* (or *Plotus*) *anhinga* is considerably smaller than in the cormorants, while in *A. leucillanti* the median raphe separating the temporal muscles back of the skull is only fibrous, and not ossified, even in adult specimens, thus clearly indicating the nature and origin of that bone. The muscular arrangement in the neck is very peculiar on account of the excessive development of the long neck-muscles in

their lower almost inter-thoracic portion, and their sudden concentration into the long and thin tendons which run up the neck. The kink of the neck makes necessary a special arrangement to prevent the tendon which runs along the posterior surface of the neck from breaking away from the vertebral column when the muscle with which it is associated contracts, and therefore a sling-band is found attached to the ninth vertebra, through which the tendon passes, acting exactly in the same way as the well-known sling-band in the knee region.



FIG. 93. — *Anhinga levaillanti*, African darter.

The alimentary canal of the darters is extremely peculiar, and has partly been described in the introduction to this volume (p. 15). We may here add that the African species has two small caeca, while the American has only one. In both the tongue is obsolete as an independent organ. It is very small in all Steganopods, but in the others it is free at its anterior extremity, which is not the case in the darters, the tongue of which is only indicated by a longitudinal groove and a slight transverse ridge behind.

The darters have only one carotid, though this character is not peculiar; for while nearly all the other Steganopods have two, there is only one in two species of pelican and one gannet.

The pterylosis of the darter is very peculiar, and Nitzsch compares it with that of the penguins, inasmuch as the contour-feathers, which are small and soft, cover the body nearly uniformly, all spaces being wanting except the lateral spaces of the trunk and a narrow inferior space.

Four very distinct species, although of very similar appearance, are known, all from the tropics or warmer temperate regions. One is American, one from India and southeastern Asia, one from Australia, and one from Africa, a distribution of the same category as that of the Heliornithidæ, Jacanidæ, *Rostratula*, etc.

In the following notes on the habits of the American species, by Dr. Brewer, are found the explanations of the two common names by which the bird is known, namely, 'darter,' and 'snake-bird,' the South American '*Anhinga*,' of Portuguese origin, having the same meaning as the latter. Dr. Brewer says: "It lives principally upon fish, which it seizes by rapidly darting upon them with its sharply-pointed and slightly-toothed beak. In this movement its neck, which is very long, is thrust forward with the force of a spring, aided by the muscles that are large and well developed in the lower and anterior portion of the neck. This is said to be the very first among fresh-water divers, disappearing beneath the surface with the quickness of thought, leaving scarcely a ripple on the spot, and reappearing, perhaps, with its head only above the water for a moment, at a place several hundred yards distant. If hit, and only wounded, this bird readily baffles all the endeavors of the sportsman to secure it. When swimming, and unmolested, it is buoyant, and moves with its whole body above the water; but when in danger it sinks its body, leaving only the head and neck out of the water, presenting the appearance of a portion of a large snake."

Dr. Jerdon's account of the Indian species (*A. melanogaster*) indicates a cormorant-like feature in the habits of the darter well worth mentioning. He says that they hunt singly in general, or in scattered parties, but often roost in company, both at night and in the middle of the day, when numbers may be seen perched on the trees overhanging some tank or river. After feeding for some time, they perch on the boughs of a tree, or on a pole or stone, and spread their wings out to dry, as the cormorants do.

The darters, like the cormorants, lay four eggs, — light blue, with a white chalky covering; in fact, typical cormorant eggs, and greatly different from the single egg of the tropic-bird, which seems to resemble the eggs of the petrels.

LEONHARD STEJNEGER.

ORDER XI. — OPISTHOCOMI.

The extraordinary bird, *Opisthocomus cristatus*, which is the sole species of the family OPISTHOCOMIDÆ, has been for a long time a complete puzzle to naturalists, as it seemed to combine within itself characters of so many groups, that it was almost impossible to decide where it should be referred, and therefore by various writers it has been assigned from one family to another, until there appeared to be no resting-place for it anywhere. Of late years, however, several entire specimens having been obtained preserved in spirits, its myological and osteological structures have been thoroughly studied by several fully competent naturalists, and the general verdict is, that, while allied to several, it belongs to none of the other groups of birds, but constitutes a distinct order and family, of which it is the only known representative. Outwardly it is not an ungraceful looking bird; having the upper part of the body dark brown, with a white streak upon the feathers of the hind part of the neck; head covered with a long loose crest, and a bare skin around the eye. Two white bars cross the wing, formed of the tips of the wing coverts. Throat and breast deep fawn, belly and crissum rufous. Tail long and colored like the back, the feathers tipped with brownish white. Its pterylosis, or feather-tracts, presents, among others, some of the following characteristics: There are no lateral neck-spaces. The inferior tract beginning at the bottom of the neck runs in two broad bands to the keel of the sternum, where they narrow, and pass on — growing gradually narrower — to the anus, terminating in only two feathers in width. The dorsal tract divides between the shoulders into two limbs, and becomes broader from the caudal pit onwards, enclosing the oil gland, which has a circle of feathers at the tip. The skeleton has many peculiarities, among which the following may be mentioned: The antepenultimate dorsal vertebra is free; the six or seven hindermost cervical vertebræ only have very weak median inferior crests, and the inferior faces of the centra of the dorsal vertebræ are flattened and without crests. The sternum is unique, the lateral edges are nearly parallel for two thirds its length, then diverge so that it is wider posteriorly than anteriorly. The posterior edge has two notches on either side, the outer pair possibly foramina, the inner pair deeper, but not extending a sixth of the sternum's length. The keel is very small and cut away in front, and has a prominent tubercle at its distal extremity (*carina sterni*), with a somewhat flattened surface, and separating the fibres of the pectoral muscles at this point. This expansion of the sternum is covered by the bare skin, and can be readily seen when the bird is picked. The sternal ribs are attached to the anterior half of the lateral margin. The coracoids are ankylosed with the clavicles; the furcula is very short, and it is so completely ankylosed with the coracoids as to leave no trace of their distinctness; and inferiorly the straight hypocleidium is completely ankylosed with the manubrium. The pelvis is without any ilio-pectineal process, and the ilio-sacral fossæ are completely roofed by bone. The skull has no basipterygoid processes; the vomer is slender and compressed, and the maxillo-palatines are ill-developed. The transverse hinge of the rostrum lies behind the lacrymals, which are coalesced with the nasals and form part of the rostrum. The crop is enormous, occupying all the upper part of the chest, and by its great size, distorts the furcula and sternum, and entirely conceals the superior and anterior halves of the pectoral muscles, and, when it is removed, the upper halves of the pectorals are seen to form a deep cavity in which the crop is placed. The above

somewhat technical description is rendered necessary from the very peculiar position this species assumes among birds, and although it may be deemed 'dry reading' it may be permitted in view of the explanation needed why the hoatzin, as it is called, should constitute an order by itself. Not much is known of the economy and habits of this species. It is a native of Guiana and the country watered by the Amazon. It abounds on the low shores of that river, and about the lakes, goes in small flocks of from ten to twenty individuals, and feeds on the leaves of the *Arum arboreum*, which give to it a very disagreeable odor. Its flight is slow and heavy, and it is not seen on the ground nor on high trees, but remains upon the branches of the arum. The nest is composed of sticks loosely laid together, and placed on low bushes near water.

On April 14, 1884, Mr. E. A. Brigham, in a paper read before the Chicago Academy of Sciences, gave an account of a remarkable discovery made by him regarding this curious bird, which would seem to show that, for a period after issuing from the egg, it might be considered as almost belonging to the quadrupeds. The following extract contains the pith of his announcement. "While making embryological studies in the interior of the great island of Marajo, on the small river Anabiju, I discovered the quadruped bird. After examining many specimens of various ages, I found that from what corresponds to about the embryonic state of development of the common fowl at the tenth day of incubation, the fore feet showed their characters unmistakably throughout their egg-development, and to a period of several days after hatching the fore feet, toes, and claws held their characters as such, as unmistakably as those parts of the posterior members. Later a progressive modification manifested itself by reducing the digits, exfoliating the claws, and developing these anterior members into those characteristic of a bird. There is, among the higher vertebrate animals so far as I know, no other example of post-natal metamorphosis in such fundamental organs to anything like this extent. The law enunciated by Von Baer—that the phylogenetic development is represented in the ontogenetic—has a wide expression here. An important ancestral feature is persistent *beyond* the egg or parental development. The animal, progressing in its embryonic course, passes into its reptilian ancestral type, and before its evolution has carried it through this, its reptilian phase, it emerges from the egg. Thus from an egg laid by a two-footed, two-winged bird hatches a quadruped animal. For several days after hatching it retains its quadruped character, then, in the open air and sunlight, one pair of legs evolves into wings. Front legs are purposeless in a bird." A confirmation of these statements is greatly to be desired.

ORDER XII.—GALLINÆ.

This great division of the class Aves, sometimes designated as Rasores, from the habit indulged in by its members of scratching the earth when searching for food, is composed of two sub-orders and four families, viz., Tetraonidæ, Phasianidæ, Megapodidæ, and Cracidæ, containing among them between three and four hundred species. The sub-orders are called respectively the Alektoropodous Gallinæ, those having feet like a fowl, containing the first two families, and the Peristeropodous Gallinæ, or those with feet like a pigeon, which includes the last two families. The two sub-orders compose the group known to naturalists as Alektoromorphæ.

The order Gallinæ contains within it those species of birds which are most important and valuable to mankind, affording food to multitudes of people, and which are

the source of all the domesticated poultry throughout the world. As a general rule, they are birds with stout legs and feet, rather small heads with curved bills, the nostrils placed in a membrane covered by a scale, moderately long necks, and heavy bodies with short rounded wings. The tarsi of the males are frequently armed with one or more spurs, and in some species this weapon is present on the legs of the female also. In the pigeon-footed families the hind toe, or hallux, is on the same plane as the three others, which are directed forwards; but the fowl-footed have the hallux usually very small and raised, sometimes barely touching the ground. The sternum has a double bifurcation on each side, the fissures wide and deep, and provides but little space for the attachment of the pectoral muscles. These last are, however, well developed, giving the plump appearance characteristic of these birds. The tail is frequently short, of various shapes, but in the Phasianidae it is sometimes lengthened to an extraordinary degree. The flight is labored, but rapid, and not often extended to any considerable distance. The œsophagus is dilated and forms what is called the crop, which receives and moistens the food. The gizzard is very strong, having a thick and hard interior wall, and, in order to assist in grinding the food, the birds are accustomed to swallow small stones, etc. The cæca are frequently highly developed. The species of this order lay numerous eggs, and the young are at first covered with down, and are able to run and feed from the moment of birth.

SUB-ORDER I. — GALLINÆ ALECTOROPODES.

The family TETRAONIDÆ is composed of the quails, partridges, and grouse, and is represented in almost every part of the world. It has been divided by naturalists into various sub-families, but three would seem to be sufficient for all the species. These are *Perdicinæ*, *Odontophorinæ*, and *Tetraoninæ*. They differ very considerably from each other. The first is a very extensive group, comprising among its species the smallest met with among the Gallinæ. It is exclusively an Old World group, no representative having been obtained in the western hemisphere. The *Odontophorinæ*, on the other hand, are only found in the New World, and are known as the American partridges, differing from those of the eastern hemisphere, among other characters, by having the mandible notched on either side. The members of the third sub-family, *Tetraoninæ*, are inhabitants of both hemispheres, one species being found through the Arctic regions of the world. They are large birds, distinguished from the rest of the family by having the legs and feet densely feathered; in one genus, however, (*Bonasa*) the feathers extend only to the knee. They have heavy, plump bodies, with short tails, and generally a plumage of contrasting colors suitable for concealing them among the herbage in which they dwell.

Of the *Perdicinæ*, the genus *Coturnix* has representatives in most of the countries of the Old World, the familiar *C. communis*, or migratory-quail, being its best known species. This little bird travels in great bodies, mainly at night, from its winter homes, generally in the southern portions of its habitats, to the localities selected for its breeding-places, returning again, as the seasons revolve, to warmer climes. It feeds mainly on grass, seeds, grain, and insects of various kinds, and is rarely seen save when flushed by man or dog. During its migrations, great bodies of water, like the Mediterranean, are crossed, and sometimes, after such long flights, the birds become so exhausted as to permit themselves to be picked up by the hand on first reaching

the land. The female lays from eight to twelve eggs. About six species are generally included by ornithologists in this genus; one, *C. delegorguei*, from Africa; *C. coromandelica*, from India, known as the rain-quail; *C. pectoralis*, from Australia; *C. novæ-zelandiæ*, as its name implies, from New Zealand; *U. caineana*, from China, and *C. communis*. They are all similar in size and appearance, and a description of the habits of one species would practically answer for all.

Australia possesses a genus of quails peculiar to itself, — *Synoicus*, — containing four species. They vary in length from six and one half to eight and one half inches; of a dark-brown color on the back, transversely barred with gray, black, and chestnut; the under surface grayish-buff or gray, with black zig-zag markings. These, like the species of quail generally, migrate but slightly, if at all, and keep in coveys, flying but a short distance after being flushed.

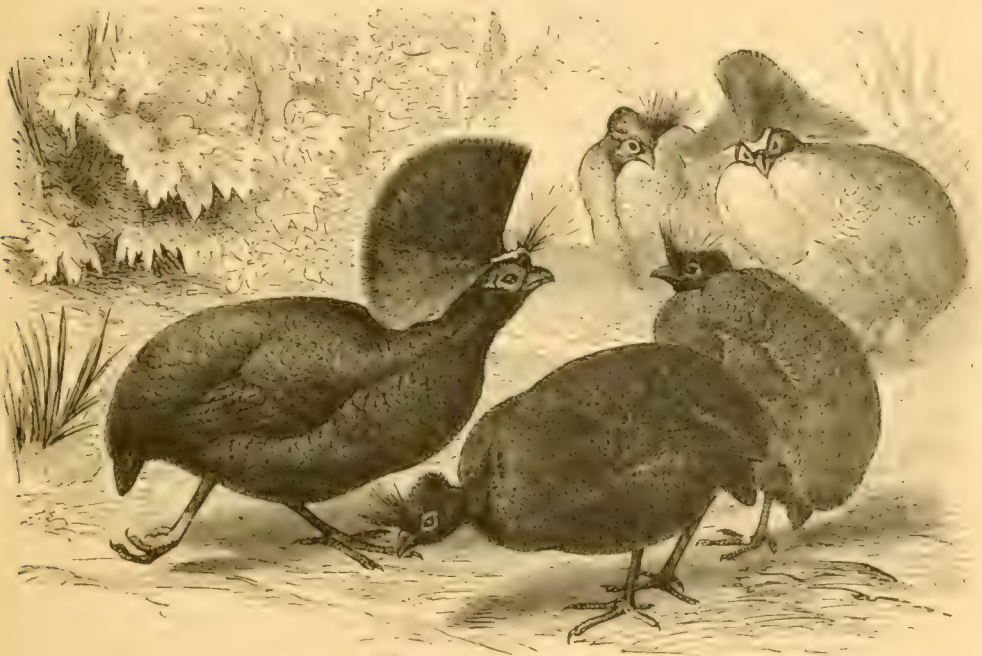


FIG. 94.—*Rollulus roulroul*, red-crested wood-quails.

The bush-quails are contained in the genera *Perdicula*, *Ophrysia*, and *Microperdis*, represented by about six species. They are distributed throughout various portions of India in the thick jungles and bushy tracts, keeping in coveys usually of from six to ten individuals, lie very close, and fly but a short distance when disturbed, and live from the level of the sea to eight thousand feet of elevation. One species, *Perdicula raaltenii*, appears to be restricted to the island of Timor.

The painted-quails are a group of very small birds (one species, *E. minima*, from Celebes, being the smallest game-bird known), and have been gathered together into a separate genus, — *Excalfactoria*. They are very pretty birds, the sexes being quite dissimilar in plumage, and are residents of various parts of India, Malay Peninsula, Ceylon, China, Celebes, Philippines, Australia, New Guinea, the Duke of York Islands, and west Africa. The best known, *E. chinensis*, the blue-breasted quail, is an

extremely pretty species, the male being olive-brown above, barred with black; forehead, lores, cheeks, ear-coverts, and breast dark purple-gray; chin and throat black, enclosing from the base of the mandible a white triangular patch; lower part of throat white edged with black; middle of abdomen, vent, and under tail-coverts deep chestnut; bill black, legs bright yellow, length about five inches. The female has a whitish chin with a rufous throat, the upper plumage generally dark brown and black with buff stripes on each feather, lower parts buff, with black cross-bars on the flanks. Hume says in India they are found singly or in pairs, and not in coveys, except just after the breeding season, when the old birds and their young are together. Swampy grass lands or meadows are their chief haunts; they fly swiftly and straight for about seventy yards, and not more than a foot above the tops of the grass. They feed on grass seeds, lay about six olive brown eggs speckled with reddish brown, and probably breed twice a year.

The genus *Rollulus* contains but two species, inhabiting Malacca, Sumatra, and Borneo, one, *R. rouloul*, penetrating into southern Tenasserim. Some ornithologists divide the species into distinct genera, placing *R. niger* in the genus *Melanoperdix*. The red-crested wood-quail, as the *R. rouloul* is called, is a very beautiful species with a rich green plumage, and a long, red, hairy crest upon the back part of the head. It is a forest-loving bird, ranging from the sea-level to a height of about four thousand feet, goes in small flocks of seven or eight individuals, lives on seeds, berries, insects, etc., and rarely comes into the open country. It is quick in its movements, and has a soft, mellow whistle. The female has a lighter colored plumage, and is without the red crest. This species is noted for having the hind claw almost obsolete. A very beautiful bird allied to the last and called *Hamatortyx sanguineiceps*, is also a native of Borneo. The general color is dark brown, with the top of the head, crest, and face crimson, throat, neck, and breast deep chestnut, under tail-coverts black, lengthened ones crimson.

With the genus *Perdix* commences the true partridges, of which *P. cinerea*, the gray-partridge of Europe, is the most familiarly known. Five species may be included in *Perdix*, viz., the one mentioned, *P. barbata* of eastern Asia, *P. robusta*, Altai mountains, *P. hodysonia*, Thibet (sometimes placed in the genus *Saxfa*), and *P. madagascariensis*, of Madagascar, by some placed in the genus *Magaroperdix*. These are all fine large birds, affording sport and food to many people. The sexes are very much alike in plumage. The gray-partridge would be a valuable addition to the game birds of any land. The female lays from eight to twenty-four eggs, the flesh is plump and well flavored, and the bird is not of a particularly delicate constitution. Sometimes, when food is scarce, this species will leave a district it has been frequenting, and pack in flocks of a hundred or more, as the pinnated grouse are in the habit of doing, and then the birds are very wild and difficult of approach. The flight of the gray partridge is swift and sometimes protracted, and it rises with a loud whirring sound. The Thibetan partridge, *P. hodysonia*, apparently is accustomed to live at great elevations (it having been met with at a height varying from sixteen to eighteen thousand feet), on desolate ground having no grass nor bushes, but only patches of mossy herbage. Yet at this great height a nest and eggs were discovered; the nest a mere indentation in the ground, the eggs pale drab in color, tinged with reddish brown at the ends, and ten to fifteen in number. Two very pretty species of a general rich buff-brown color, with gray crowns and cheeks; forehead and line over the eye black, and breasts vinous fawn, have been placed in the genus *Ammoperdix*. They frequent

rocky ground and ravines, are very gentle, and feed on seeds and such herbage as grows in the localities they inhabit. One species, *A. bonhami*, is found in India, Afghanistan, Persia, and Beluchistan, while the other, *A. heyi*, is a native of western Arabia, the Sinaitic Peninsula, Egypt, Nubia, and Palestine. A partridge from west Africa, of a general earthen-brown plumage, closely allied to the birds of the genera *Perdix* and *Ammoperdix*, has been separated by Swainson as a sub-genus, and called *Ptilopachus ventralis*. The two lateral toes are nearly equal in length; the tail is much developed, and the nostrils occupy almost one half the length of the mandible. The shafts of the feathers on the back and rump are thickened as in the pigeons. The single species is the only representative of the genus.



FIG. 95.— *Caccabis rubra*, red-legged partridge.

Thirteen or fourteen species are included in the genus *Aborophila*, or hill-partridges, the greater portion (nine) being found in India and Burmah and the Malay Peninsula, two are found in Java, one in Sumatra, one in the island of Formosa, and one in the Philippines. They are forest-loving birds, live in mountainous districts in the densest thickets, go in coveys, and have a whistling call. The sexes differ slightly in plumage. The Formosan bird has been separated under the generic title, *Oreoperdix*, and has a bare, bright-red throat in the breeding season.

The red-legged partridges, together with the species of *Ammoperdix*, have been considered by some writers as worthy of constituting a sub-family of the *Perdix* family, but while perhaps not quite entitled to that distinction, they do nevertheless form a well-marked group. The species have a wide range and are spread over temperate Europe,

western and central Asia, Madeira, the Canary Islands, and Açores. The genus *Cucubis* contains about six species, with an unmottled plumage, with bright-colored bands on the flanks, and a general ashy and buff coloring, admirably adapted to conceal the birds in the rocky grounds they frequent. As a rule they are not very good eating, being dry and not very tender, although the young, when kept for a time and properly cooked, are said to be very good. They are extremely pugnacious, and it is stated that in former ages they were kept tame for fighting, as game-cocks were, and that the Emperor Alexander Severus was very fond of this sport. They are hardy birds, braving extremes of heat and cold, and in Persia are found in the Elburz mountains, at 10,000 feet elevation. They do not lie well to the dog, but run swiftly, and take flight when out of range of the gun, and consequently are not favorites with sportsmen. In fact, as game-birds, they have little to recommend them beside their handsome appearance. The nest is merely a hole scratched in the ground, and the number of eggs varies from nine to as many as twenty-four. The red-legs are noisy birds, calling mostly in the morning and evening; and when a covey is scattered, each individual, says Hume, proclaims his own and inquires his fellows' whereabouts. The tone varies. First he says, "I'm here," then he asks "Who's dead?" and when he is informed of the decease of some favorite relative, or perhaps his eldest son, he responds, "Oh lor! oh lor!" in quite a mournful tone. The various species feed on grain, seeds, insects, caterpillars, etc., and also on tender shoots.

The splendid birds known by the trivial name of snow-cocks or snow-pheasants, are dwellers, as their name implies, of high elevations on the gigantic mountains of the Himmalehs, and of the Altai, also in the Caucasus range. They are met with in Asia Minor, Armenia, Kurdistan, and Persia, while one species, the *S. thibetanus*, is found not only in Thibet proper, but also in the mountains of western China. They range at from 6 to 18,000 feet in elevation, descending to the lower heights in winter after heavy snow. They are large birds and extremely shy, go in packs occasionally of twenty to thirty individuals, though five to ten is the more usual number. In summer generally but a pair are found together. When feeding, a sentinel is always posted on some commanding spot to give notice of any danger, and as they resort to the rocks and never enter forest or long grass, it is exceedingly difficult to approach them or take them unawares. They breed early in the spring, and the young are very skilful in hiding among the stones. The number of eggs laid is from six to nine, of pale olive color, with light or dark red spots. The nests are hollows scraped in the earth, and lined with grass and a few feathers or green fir-needles. The sexes differ slightly in plumage, mainly about the head and breast. In size they vary from a length of nineteen to twenty-nine inches, and in weight from three to six and a half pounds. The genus *Lerica* contains only one species, the *L. nivicola*, known as the snow-partridge, which ranges for a thousand miles along the Himmalehs, and into Thibet and western China. In winter it descends to an elevation of 7,000 feet, its summer abodes being at from 10,000 to 14,000. In habits and haunts this bird much resembles the snow-cocks, but it prefers a mossy vegetation to that of a grassy character. It is generally very tame and will permit one to approach quite near, when it utters a harsh whistle, but it is exceedingly difficult to distinguish the bird from its surroundings if it remains motionless. It breeds near the snow-line, and the eggs are stated to be large, dull white and freckled all over with reddish brown. It is a handsome bird, the whole plumage being minutely barred with black or buffy white, and tinged with chestnut on the side of the neck. The chin is grayish, throat, breast, and upper part

of abdomen deep chestnut red, with dashes of buff on the flanks. Tail dusky, with bars speckled with gray and rufous. The male has short spurs, and weighs from sixteen to twenty-two ounces.

The bamboo-partridges, so-called from their habit of haunting dense grass or bamboo jungle, are four in number, and compose the genus *Bambusicola*. They differ from all the other species of this family which have thus far preceded them, save *L. nivicola*, by the presence of sharp spurs on the tarsi of the males. They are rather large birds, of a reddish-brown plumage. Two species are found in China, one in Burma and one in Borneo. Allied to these is *Caloperdix oculens*, a very handsome gamey-looking partridge, the male not infrequently having double spurs. It is a rare species, and but little is known of its habits, for its chosen abode is the dense and primeval forests of the Malay Peninsula, through which wild elephants and buffaloes make the only paths. The head, neck, and under parts are bright rufous, flanks barred with black. Mantle black, feathers edged with white, back and upper tail-coverts black, with V-shaped marks of bright rufous. Wings reddish-brown or grayish, each feather with a black spot near the tip. Its length is about eleven inches, its weight half a pound.

The francolins constitute a very extensive group, having rather lengthened bills and tails, and generally a rich plumage of contrasted colors. The rather restricted genus *Francolinus* (of which *F. vulgaris* is the most familiar species) is Asiatic, and contains but three species. At one time an inhabitant of Europe, the common francolin is now quite extinct on that continent, but is still found on the island of Cyprus; but in Asia Minor, Palestine, and throughout northern India, Armenia, Persia, and Beluchistan it is quite plentiful. The male is a bird of very handsome plumage, with the sides of head, cheeks, throat, and lower parts deep black; crown brown with black spots; a broad chestnut collar round the neck. Breast and flanks spotted with white, and the abdomen, which is rufous, is barred with the same. A line of white under the eye. Back and wing-coverts blackish-brown; rump and upper tail-coverts black barred with white; under tail-coverts chestnut tipped with white; tail black and broadly barred with white; legs reddish orange, and have a short blunt spur. This is a favorite game-bird with sportsmen, is strong on the wing, flying very steadily, lies very closely to a dog, perhaps too closely, and its flesh is very fair food. It frequents meadows, cultivated fields, patches of herbage, and jungle. When flushed, it springs perpendicularly into the air to the height of perhaps three feet, before taking its line of flight. They do not go in coveys, but keep in pairs, although many pairs may be in close proximity to each other, and are monogamous. At earliest dawn, wherever these birds are present, their clear call rings out on the morning air with a "Be quick, pay your debts," sort of a exclamation, and this habit frequently leads to the discovery of their place of refuge, and to their ultimate destruction. The usual number of eggs to a nest is from six to ten, of a dull greenish-white color, and the nest is generally a depression in the ground at the foot of some grassy tuft, and partially lined with roots and grasses. The common francolin varies greatly in size among individuals, those from Asia Minor being generally the largest. Like many other species of game-birds, old or barren hens sometimes assume the male plumage, and albinos are not uncommon. The other species of this genus are *F. pictus* of central and southern India, and *F. chinensis* of Pegu, India, and southern China.

The remaining portion of the group of francolins are African, and about thirty in number. They have been divided into four genera or sub-genera—*Clamator*, *Sclerop-*

tera, *Pternistes*, and *Charopus*. They are large birds, sometimes called pheasants, and are very abundant in different portions of the 'Dark Continent.' In habits they resemble the common francolin, prefer running to flying, and feed during the morning and evening on grain, insects, and bulbs, which last they dig up with their powerful bills. The males and old females are armed with spurs on the tarsi, and, when disturbed, the species will frequently take refuge in trees, where they also roost. They appear at times to be migratory, caused possibly by the abundance or scarcity of food or water in certain localities. They are very noisy birds, and in one species, *S. adspersa*, the voice can be heard at a great distance, the notes uttered resembling a succession of hysterical laughs.

A genus of gray partridges, styled *Ortygornis*, containing but two species, is found in India and Ceylon. They are birds of the lowlands, one of the species, *O. gularis*, having been met with as high as four thousand feet, and *O. pondicerianus* at five thousand feet, which in that land of gigantic peaks is but the summit of a hill. The individual of the last-named species was deemed, however, but a straggler, and was evidently above his range. The flesh is said to be hard, dry, and insipid, hardly worth eating, cook it as you may. These species are extremely pugnacious, and are kept by the natives for fighting, as partridge combats are one of their chief amusements. The *O. gularis*, whose trivial name is the swamp-partridge, affects, as its name implies, marshy lands and banks of rivers, jungle, thickets, and reed-beds, but always near water. When flushed, it rises with a loud whirr, and a shrill cackle, but does not fly far, and if not bagged can only with great difficulty be forced to take wing again. They are wary and difficult of approach, one of their number being generally posted as a sentinel on the top of a bush, and they keep together in small parties or in pairs. The males are heavily spurred, sometimes having two spurs on each leg, and it is stated that every one examined will be marked with scars from wounds obtained in fighting. The nest is placed on the ground, and the eggs number about five. The *O. pondicerianus* breeds twice a year, laying seven to nine white eggs tinged more or less in depth with a light coffee-color. These birds weigh from nine to twelve ounces and are from eleven to fifteen inches in length.

A rather curious partridge with a very long bill is found in Malacca, Sumatra, and Borneo, and is known to naturalists as *Rhizothera longirostris*. It is about a foot in length, and the bill is as powerful as that of a peacock. It has the throat, sides of the head, upper part of neck, belly, and flanks rufous yellow; top of head and back chestnut brown with large black spots; lower part of neck and breast leaden gray; rump and upper tail-coverts are rufous, crossed with fine zigzag lines of a darker hue, and in the centre and near the end of each feather is a spot of yellowish ochre. A bare red skin encircles the eye. The primaries are rufous, barred with brown. The tarsi are armed with short heavy spurs. The female resembles the male, except that her breast is ferruginous instead of gray, and she has no spurs.

The last genus of the *Perdicinæ* is *Galloperdix*, consisting of three species; two, *G. spadiceus* and *G. lemlatus*, being peculiar to India, and the third, *G. zeylonensis*, only found in Ceylon. They are rather peculiar birds, resembling in some of their characters the true jungle-fowl of the genus *Gallus*, having nude skin around the eyes, but without comb or wattles. The sexes are dissimilar, and both are armed with spurs, the male sometimes having as many as three on one leg, occasionally two on one leg and one on the other, the female also at times possessing the same number of weapons. They dwell entirely in woods, and in localities affording dense cover, such

as jungle-clad and rocky hills, straying rarely to the alluvial plains, and never remaining in open districts. They ascend the sides of wooded hills as high as five thousand to seven thousand feet, are always extremely shy and wary, most difficult to flush, preferring to effect their escape by running, as they are very swift of foot. Except during the breeding season they go in small flocks of from five to ten, are exceedingly pugnacious in disposition, and fight with head depressed like common fowls. The hen lays from four to ten coffee-colored eggs, and breeds more than once each year. This species has a kind of cackling cry, most often heard when a covey has



FIG. 96. — *Lophortyx californicus*, California quail.

been broken up and its members are desirous of getting together again. They have a very handsome plumage, but their flesh is considered dry and rather insipid, unless perhaps when the bird is very young.

The American partridges are kept distinct from those of the Old World in the sub-family Odontophorinae, chiefly from having a bidentation at the end of the mandible, although in some of the species this is hardly apparent. The group consists of nine genera with about forty-five species, some of which are very graceful birds with a beautiful plumage.

Two genera, *Dendrortyx* and *Odontophorus*, contain species of large size, distributed throughout Central and South America. They are forest-loving birds, and go in flocks of six or eight. Some species frequent the ravines of volcanoes in Central

America, near their tops, in the sunny spots made by fallen trees, and when frightened run swiftly, only taking flight when approached quite suddenly. In Brazil, *Odontophorus dentatus* is said to resemble the hazel-grouse of Europe in its mode of life, never appearing in the open country, but always remaining in the thick woods, and feeds on fruits, berries, insects, etc. In the morning and evening it is accustomed to perch on a branch, several individuals in a line, and the male utters a loud cry which reverberates to a great distance. It nests on the ground and lays from ten to fifteen pure white eggs. When flushed, the birds fly to the trees, where, amid the dense foliage, it is very difficult to perceive them. The flesh is palatable, and the sexes, like all the species of the genus, differ but little in the color of their plumage.

Two beautiful species constitute the genus *Lophortyx*, *L. californicus* and *L. gambelii*. They bear some resemblance to each other, both having black throats, and sides of the head marked with white, blue breasts, and a black crest composed of from five to ten feathers springing from one spot. These are enlarged at the top and curl over forwards. The webs bend backward, and fold over the feather succeeding, and all form one bunch, usually drooping forward, but freely movable. The hen's crest is shorter, and brownish in hue. The species differ greatly in the coloring of the lower parts. The *L. gambelii* has the upper part of the abdomen buff, lower part black, while the *L. californica* has the upper part golden brown, rest chestnut, each feather edged with black. This latter species is found in Washington Territory and California, while the *L. gambelii* is a native of Arizona, New Mexico, and northern Mexico.

The mountain-quail, or plumed-partridge, as the *Oreortyx pictus* is usually called, is a large and very handsome bird. Its habitat is limited, being exclusively the mountain ranges of California and Oregon. The head is ornamented by two long slender feathers arching towards the occiput, the throat is chestnut, neck and breast dark gray, sides and abdomen deep chestnut; the feathers of the former edged with white, those of the latter banded alternately with black and white. It utters a faint chirp when alarmed, associates in flocks of fifteen or twenty, lives on seeds and insects, and the flesh is excellent. *Callipepla squamata*, the blue-quail of Arizona and Mexico, has a soft, full crest of short feathers, and differs from all the group of so-called quails in America by presenting little or no variation in the plumage of the sexes. It is especially a terrestrial bird, rarely taking refuge in trees or bushes unless very hard pressed, but runs over even difficult ground with much swiftness. Like all quail, the hen lays a large number of eggs, and their color in this species is buffy white, thickly dotted with light-brown specks. *Eupsychortyx* is the last genus containing the plumed or crested-partridges. The species are natives of Mexico, Guatemala and northern South America, and are all provided with short, soft crests, and are very abundant in the localities they frequent. Three very peculiarly appearing species are contained in the genus *Cyrtonyx*, their heads being striped with black and white after the manner of a clown in the circus. They dwell in Mexico, one species only, *C. massena*, extending its range north into Arizona. They are stated to be very gentle in their habits, exhibiting but little fear of man, go in small coveys, and live chiefly amid wild, rocky and barren tracts.

Ortyx virginianus, our familiar "Bob White," with his relatives, *O. floridanus* of Florida and *O. texanus* of Texas, is most widely and generally known. It is the quail of the northern and the partridge of the southern United States, and is widely disseminated over the eastern states and portions of Canada. It is so well known, both

as to its appearance and habits, that it will be unnecessary to devote any space to it here. Cuba possesses a species very similar in plumage, *O. cubensis*, differing mainly in the greater extent of black upon the head and upper part of breast. A beautiful species, *O. nigrogularis*, is a native of Honduras and Yucatan, having a black throat, and a white breast and abdomen, the feathers of these being bordered with black. The remaining species of the genus, three or four in number, are found in Mexico, one only *O. leylandi*, being a native of Honduras and Costa Rica.



FIG. 37. — *Lagopus albus*, ptarmigan, in summer plumage.

The grouse comprise the sub-family Tetraoninae of the *Perdiciidae*, and are distinguished from the quails and partridges by having the nostrils, legs, and feet more or less completely feathered, by a bare skin over the eye, a pectination on the sides of the toes, and in some species by a bare distensible skin on the side of the neck. They are confined generally to the northern districts of both hemispheres, but are most numerous in North America. They are usually contained in eight genera, with one or two sub-genera, and consist of about twenty-three or twenty-four species.

The ptarmigan, comprising the genus *Lagopus*, differ from the typical grouse by having the toes as heavily feathered as are the tarsi, and also, with one exception, by

changing their summer plumage at the approach of winter, to one of a pure white. They dwell among the snow-clad hills and peaks, are monogamous, both sexes devoting themselves to the care of the young; and but one brood is raised, as a rule, in a season. The eggs are about a dozen in number, varying in color from buff to a bright rufous, thickly spotted and blotched with black. While the hen is incubating, the male remains in the vicinity and keeps a bright look-out for enemies of every kind. One species is restricted to the New World, *L. leucurus*; three to the Old World, *L. scoticus*, of Great Britain and Ireland, *L. hemileucurus*, doubtfully distinct from *L. rupe-*



FIG. 98.—*Lagopus albus*, ptarmigan, in winter plumage.

tris, from Spitzbergen, and *L. mutus*; while *L. albus* and *L. rupestris* are inhabitants of both hemispheres. They go in flocks, are not wild when not much hunted, and their flesh is tolerably good for food. An exception may be made for the Scotch grouse, whose flesh is excellent, but this species, from causes perhaps incident to its insular existence, has lost some of the ptarmigan traits, and adopted others pertaining more to those of the true grouse. Although apparently nearest allied to the *L. albus*, of which it may be considered an island form, it does not turn white in winter, and is chiefly a bird of the moors, ascending at times, however, to the base of the higher peaks. It varies in the colors of its plumage according to the localities it frequents, those individuals inhabiting rocky ground being usually lightest in hue.

Lagopus leucurus, the white-tailed ptarmigan, inhabits the Rocky Mountains from the Arctic Ocean to latitude 37°; *L. rupestris* is found in Iceland, Greenland and Arctic America, and *L. mutus*, the common ptarmigan, is met with in the higher portion of the mountains of Scotland and northern Europe, and on the elevated ranges of southern Europe.

The genera *Pediaccetes* and *Cupidonia* comprise those grouse generally known as sharp-tails, prairie-hens, or prairie-chickens. The first contains one species composed of two geographical races, which, while differing considerably in appearance in individuals most widely separated in their habits, blend together when the two styles meet at the border of their respective ranges. The northern form, whose markings are mainly black, has a white throat spotted with black, and is known as *P. phasianellus*. It ranges in the interior of British America west to Fort Yukon, and south nearly to the United States boundary, where it meets the well-known sharp-tail grouse, or white-breasted prairie-chicken, which inhabits the northwestern portions of the United States, and southwards to Colorado.

The *Cupidonia cupido*, or common prairie-chicken, which at one time inhabited all of the north-eastern part of the United States, is now only found from Illinois westward to the eastern foot-hills of the Rocky Mountains, and south to eastern Texas. A few still linger in certain localities in the eastern states, notably on Martha's Vineyard, off the coast of Massachusetts. In western Texas a small form, called *C. pallidicinctus* takes the place of *C. cupido*. The habits of all these birds are very similar, and too well known to need recapitulation here. They all possess gular sacs (the member of *Pediaccetes* in a rather restricted degree), and by their inflation and contraction cause the booming tones that resound over the prairies in the early spring. The sacs in the members of the genus *Cupidonia* are covered by lengthened feathers, which are raised when the bird is excited. From the continued persecution which the species inhabiting the United States are subjected to by hunters and trappers, and the utter disregard shown for the laws passed to protect them at certain seasons, they are yearly becoming scarcer, and the time cannot be far distant when these fine birds will no longer exist within our borders.

The sage-cock, or cock-of-the-plains, *Centrocercus urophasianus*, is the largest grouse found in America, and nearly rivals in size the European cock-of-the-woods, but it weighs much less, the heaviest male not often exceeding six pounds. The female, as usual, is much smaller. It is dispersed over the western plains, in the almost desert region where the *Artemesia* or wild sage grows, which plant affords the bird its principal food, and consequently, from its bitter character, the flesh of this grouse is very unpalatable. The sage-cock is chiefly remarkable for its lengthened tail of twenty narrow, stiff feathers, which terminate in points, and also for the enormous air-sacs of yellow skin, on either side of the neck, bordered by stiffened, scale-like feathers. These sacs in the spring are inflated, and as the air is being exhausted a sound is produced of a deep, hollow tone, like that arising from blowing into a large reed. The upper parts are brown, varied with gray, black, and buff, and the under parts below the breast are black, less noticeable in the female. Differing from other gallinaceous birds, the sage-cock has no gizzard; the stomach, instead of being hard and muscular, is soft and membranous, as in the birds of prey.

The generic term *Tetrao* was formerly employed for nearly all grouse except the ptarmigan, but even in its restricted sense as used by later writers, some of its members have been again separated either generically or at least sub-generically. Thus the

North American blue-grouse have been placed apart under the term *Dendragapus*, containing the dusky, blue, or pine-grouse, *D. obscurus*, of the eastern foot-hills of the Rocky Mountains, south into Mexico, and its barely separable ally, Richardson's grouse, *D. richardsoni*, of the central Rocky Mountains from South Pass north to Hudson Bay Territory, with its jet black, square tail, differing in this point from the rounded black tail, with its terminal gray bar, of *D. obscurus*. A third variety is *D. fuliginosus* from Oregon to Sitka. These birds inhabit exclusively the evergreen forests at elevations of about 6,000 feet, but in winter, in the Sierra Nevada, they descend to 2,000 feet. In the spring the males emit a prolonged sound, like the whirr of a rattan cane, caused by the inflation and contraction of two sacs, one on each side of the throat, covered by an orange-colored skin, but which are usually concealed, when collapsed, by the feathers. They are large birds, and their flesh is white and delicate.

The genus *Canace* has three species, the spruce-grouse, distributed throughout the eastern United States to the Rocky Mountains, and northward to the Arctic regions; Franklin's grouse, abundant in the Rocky, Bitter Root, and Cascade Mountains, Washington Territory; and Hartlaub's grouse, *C. (Falcipennis) hartlaubi*, from Siberia, differing from the others, beside the coloring of its plumage, by having the primaries falcate or sickle-shape. They are forest and swamp-loving birds, very tame and unsuspicious, and their flesh is dark and generally bitter. The black-cock, *T. tetrix* (sometimes placed in the genus *Lyrurus*), has a glossy black plumage with blue reflections, and the under tail-coverts pure white. It is abundant in Great Britain and on the continent of Europe, extending eastward as far as China. In the mountains of the Caucasus a second species is found, *T. mlodosiewiczzi*, differing from the black-cock by its black under tail-coverts, and by having the tail bent downward and slightly outward at the tip, the feathers trough-shaped at the ends. The black-cock is accustomed, during the breeding season, to come together in large companies, called in Sweden the 'orrlek' or 'lek.' The locality is an open place surrounded by forest trees, where the males appear before dawn and begin to strut not unlike a turkey-cock. When two or more meet during the performance, a desperate conflict ensues, not unfrequently ending in a regular rough-and-tumble fight. Unlike the capercaillie, the black-cock, while 'drumming,' is wide-awake to all that is going on about him, except when engaged in battle. After the males have been occupied with their manœuvres for a short period, frequently uttering their call-notes, the females appear upon the scene, and the pairing takes place. The female, or gray-hen as she is called, deposits her eggs, eight or nine in number, under some bushes or in the heather, and the chicks, when first hatched, are fed on ants' eggs or insects. Unlike the cock-of-the-woods, although the species under consideration frequents the forests, it prefers the moors and plains, and is very shy and difficult of approach.

The magnificent capercaillie, *T. urogallus*, with its relative, the Siberian wood-grouse, *T. urogalloides*, are the chief species of the genus *Tetrao*, and are the largest of all known grouse. The first named is still met with in Scotland, having been introduced into that country after having become extinct, and is found throughout northern Europe, and in Asia, but is replaced in eastern Siberia by the smaller species, *T. urogalloides*. All of these birds are denizens of the forests, delighting in the thick pines and firs, upon the leaves of which the capercaillie feeds. Space forbids a detailed account of the habits of this noble bird, and will permit of but a brief notice of the manner in which the male is accustomed to call the hens into his presence. The species is polygamous, and the breeding season commences towards the end of March.

The locality to which the cock resorts at such times is either on a level rock in some opening of the forest, or on the upper branches of a pine. Here he begins his performances by first uttering a note something like *pellet* repeated once or twice at intervals, and he is then on the watch for any enemy, as is also the case when he sounds his second note *kliskop*, resembling a gulp in the throat. But while emitting the third and last sound *hede! hede! hede!* the head is thrown backwards, the neck waves to and fro, the tail is raised at right angles to the body, the wings quiver, and the excited bird either pirouettes upon his perch, or slides sideways along the branch. At this moment, it is asserted, he is both deaf and blind, and knows nothing of what is going on about him, of which fact the hunter takes advantage to approach near for a successful shot. This play, or 'spel' as it is called, is frequently repeated, and the hens, on hearing the call, assemble from all points, and alight near him, often on the same tree. A little before sunrise the performer descends to some open spot, where the hens collect about him, and between the intervals of the 'spel,' which is still continued, he pairs with each member of his harem. Young cocks are not permitted to 'spel' in the presence of the old males, but are speedily driven away should any venture to approach. The cocks fight with great fierceness during the breeding season, springing high in the air and striking with their wings and claws, and endeavoring to seize each other with their bills, and, when successful in this effort, the weaker is held down to the ground and severely punished. The female scrapes a hole beneath some tree or bush, and lays from five to fifteen eggs, of a yellowish color spotted with light brown, and incubation lasts, it is said, for one month. The young remain with the mother until the next winter. The male capercaillie greatly exceeds the female in size and weight, individuals sometimes turning the scale at twelve and thirteen pounds. The upper parts are blackish-brown, each feather mottled with grayish; the feathers of the throat are elongated and black; breast black with green reflections; flanks brownish-gray sprinkled with black; under tail-coverts black, tipped with white; the tail black. The female is reddish-brown, barred and blotched with black; sides of the neck, throat, and breast rich orange, barred with black on the neck; lower parts pale orange, feathers tipped with white; tail reddish-brown, barred with blackish-brown.

The ruffed-grouse, so called from its possessing tufts of numerous wide soft feathers on each side of the neck, which the bird is capable of elevating, with its allies of both hemispheres, is distinguished from all other grouse by having the lower part of the legs bare of feathers, and constitute the genus *Bonasa*. The American species consist of the *B. umbellus* and its two sub-species or varieties, which are distributed throughout the northern United States and Vancouver Island. The Rocky Mountain form has been designated *B. umbelloides*, and is a small gray bird with rather different markings from the typical style, and a small ruff, while the variety of the west coast, known as *B. sabinei*, is a large bird of a general dark orange-chestnut color. All the forms delight in woods and dense thickets, are extremely shy, rise with a great whirring noise, fly straight and swiftly. They roost in trees, and, when disturbed, take refuge among the thickest foliage and remain perfectly motionless. The nest is placed upon the ground, composed of leaves and plants, and the eggs, ten or more in number, are yellowish or cream color, spotted with dull red. The male has a singular habit called 'drumming,' which is indulged in at various seasons of the year. He stands upon a trunk of some fallen tree, and, stretching himself into a horizontal position, beats stifflly downwards with his wings, slowly at first, increasing the strokes until they become so rapid that the wings are invisible. This produces a loud rolling

sound that may be heard at a great distance, but partakes somewhat of the character of ventriloquism, as it is difficult to locate the position of the performer. In the breeding season this may be executed to attract the females, but as the same performance is also gone through with in the autumn, it cannot always be for this purpose. Some writers state that the wings strike the flanks, others that they strike each other above the back, while others again, that they strike nothing,—the fact being that the movement is so rapid that it defies the closest observer to determine exactly what does take place.



FIG. 99.—*Bonasa betulina*, hazel-grouse.

The allies of the ruffed-grouse in Europe and Asia, the *B. betulina*, has, with two other lately described species, *B. sewarzewi*, and *B. griseiventris*, been separated by some writers into a distinct genus, *Tetrastes*. The hazel-grouse is not found in Great Britain, but is distributed generally throughout Europe and Asia from France to northern China. It has also been met with in Japan. This species is not possessed of the ruff, and is smaller than the American bird, neither does it indulge in the habit of drumming. It is monogamous, the males leaving the young to the care of the

females. The eggs, from eight to fourteen in number, are buff spotted with brown. It is a rather handsome bird, with a black throat, back ashy-gray varied with black, and the under surface of the body white mottled with brown. The female is without the black throat, but has this part fulvous white varied with blackish spots.

The great family PHASIANIDÆ is the most important of the Gallinæ, whether we consider the number, variety, and beauty of the species of which it is composed, or their great value as food-producers for the human race. It contains between eighty



FIG. 100.—*Numida cristata*, crested Guinea-fowl, and *N. pucherani*, helmeted Guinea-fowl.

and ninety species, some of which rank with the most gorgeously plumaged creatures to be found in the class of birds. Although many have been the arrangements proposed for the members of this family, as to the number both of the sub-families and genera, some writers considering that certain species should constitute separate families, yet following the latest work devoted to these birds, the Phasianidæ may be divided into eight sub-families and about eighteen genera.

The sub-family, Numidinae, contains the Guinea-fowls, consisting of those with crests,

those with bare heads and bony helmets, or those with an occipital feathery patch. There are five or six species of the first division, about four of the second, and one of the last. The first has been separated by some authors under the generic term, *Guttera*, and are much more graceful birds than those of which the common Guinea-hen, *Numida meleagris*, is the type. They have a jet-black plumage dotted over with small bluish-white or light-green spots; the bare skin of the neck is blue or purplish, some having these parts diversified with bright red. The top of the head is covered with a long, full, black crest, and the primaries are buff. Several species also have the upper part of the breast black, of a more or less extensive area, sometimes tinted with chestnut. The skin of the neck is full, and forms a pleat or fold behind and on the



FIG. 101. — *Acryllium vulturinum*.

sides. The helmeted Guinea-fowls have the upper part of the head bare, with a bony crest in the centre, varying in size according to the species, and with wattles of different shape and colors pendant from the angles of the mouth. These birds also have a general black plumage covered with white spots, *N. meleagris* also having the upper part of the breast and back brown with a lilac lustre. Two species, *N. mitrata* and *Acryllium vulturinum*, are found in Madagascar; the one last-named, and all the other members of the sub-family, are found in various portions of the African continent. They go in large flocks, are very noisy, extremely swift of foot, wild and wary. The *A. vulturinum* is a peculiar as well as a very beautiful bird, with the lower part of the neck, and upper portion of the back and breast covered with very long lanceolate

feathers, having white centres, succeeded by a line of black and fringed with blue, the black portion minutely dotted with white. The mantle is black, spotted with white; the centre of breast beautiful light blue; flanks rich purple, spotted with white, the spots encircled with black; tail like the mantle, the central rectrices long and pointed; the head and neck naked, with the exception of a patch of short chestnut feathers on the occiput.

Two curious west African birds, *Agelastes meleagrides*, and *Phasidus niger*, compose the sub-family Agelastinæ. They seem to be a kind of link between the jungle-fowl, *Gallus*, and the Guinea-hens, having bare heads and necks, and the tarsi armed with spurs. Not very much is known about them, very few specimens having been obtained. The first has a flesh-colored head and neck, all the upper part of breast and back pure white, and the rest of plumage black vermiculated with white. The *P. niger* is black, the feathers obscurely mottled with brown. Head and neck flesh-color, and a line of black feathers, very short, from the base of the bill to the occiput. This last was discovered by Du Chaillu near Cape Lopez. He states that the species is not gregarious, a male and one or two females at most being found together, and is extremely wild and wary.

The jungle-fowl compose the sub-family Gallinæ. There are four well-established species, and a possibly doubtful fifth, *Gallus stramineicollis*, from Sulu. From these gallant game-birds spring all the different species of the common fowl. Two species are island forms, *G. varius* from Java, Lombok, Sumbawa, and Flores, and *G. lafuyetti* from Ceylon. The first is remarkable for having the neck hackles square at the tips, and but a single median wattle, in place of one on each side of the face, as is usual with other jungle-fowls. This wattle, and the comb, which is not serrated, are of brilliant hues, the last being green along the head, succeeded by a narrow yellow line, then reddish shading off into dark purple, while the wattle has two thirds of the upper parts deep rose, then yellow, and the bottom deep green. The sides of the head are flesh-color, and the throat yellow, both bare of feathers. The Ceylon bird has also a curiously colored comb, which is serrated on the upper edge, of a bright red with a central yellow patch that graduates into the surrounding color. The other species are *G. sonnerati*, of southern India; and *G. ferrugineus*, of north India, Assam, Burmah, and the Malay countries; also doubtfully from Turkestan and the islands of Sumatra, Lombok, and Timor; probably imported into the last two named. As their trivial name implies, these birds are native of jungle tracts and deep forests, though they will come out into the open cultivated ground near their retreats to glean among the stubble. In such places, when approached, they take wing readily, flying steadily with rapid beats and alternate sailings, alighting at the edge of the covert, and run swiftly into some place of concealment. The cocks crow and the hens cackle the same as barn-yard fowls, but in somewhat sharper tones. The cocks usually carry the tail drooping, erecting it only when challenging a rival or paying court to the hens. The males fight desperately among themselves, and death often follows the stroke of the terrible spur. In their wild state these birds are said to be monogamous, although some observers doubt if this is always the case. The above remarks apply more particularly to the *G. ferrugineus*. Sonnerat's jungle-fowl is not gregarious, but goes only in small coveys or singly or in pairs. They like the thin bamboo jungle and evergreen forests, and only congregate in numbers where food is exceptionally plenty. This species retains its wildness in captivity and cannot easily be induced to breed. The flesh is not very good, being dry and hard, and the species is considered

by sportsmen hardly worth shooting. Although armed with very powerful spurs, they are said by some observers to be not quarrelsome, and several males and females will live very quietly together. All these species are omnivorous, eating grain, grass, leaves, seeds, fruits, insects, etc. The end of the hackles of *G. sonnerati* are very peculiar, being formed of a singularly brittle substance like a fine shaving in texture.

The sub-family Phasianinæ contains five genera, *Ithaginis*, *Euplocamus*, *Lobio-phasis*, *Thaumalea*, and *Phasianus*, comprising over forty species, some of which are the most beautiful of the Phasianidæ. The members of the genus first mentioned, known as the blood-pheasants, are by some classed with the partridges, but it would seem that they should more properly be placed with the birds of this family. They are alpine species, the *I. cruentis*, inhabiting the Himmalehs at a height of ten thousand to fourteen thousand feet. The tarsi are armed with numerous spurs, as many as five on one leg and four on the other having been observed on the males. Three species are known, the one mentioned, which is found in Nepal and Sikkim, the *I. geoffroyi*, from Moupin in north China and Thibet, and the *I. sinensis* from Chensi. Very little is known of the habits of the two last, but the longer-known species has been met with in its native wilds by several competent naturalists. The *I. cruentis* goes in flocks of twenty or thirty individuals, always in the immediate vicinity of the snow, but near the forests. In winter it burrows under the snow for protection against storm and the severity of the temperature at the great elevations at which it lives. Its principal food consists of the tops of the pine and juniper, berries and moss. Its flesh has a strong flavor, and is not very tender. The flight is of very short duration, and it quickly runs to shelter.

Euplocamus contains numerous species, some fourteen or more, and has by different writers been divided into several sub-genera, but these have not been generally adopted. The species may be classed in three divisions,—the firebacks, the silver and the kalij pheasants. The first of these is represented by six or eight species; the second by about four, and the third by three or four. The firebacks are of two styles, those with short, square, hen-like tails observed in both sexes, and those with broad, rather lengthened tails. They are birds of very rich plumage, the lower portion of the back being bright, fiery, metallic red, the face is covered with bare skin extending above the eyes, in some species almost like horns, deep blue or bright red in color, and certain ones also are adorned with full upright crests. They are natives of Siam, the Malay peninsula, Sumatra, Borneo, and Formosa. The species of the last-named island, *E. swinhoi*, may not strictly be included among the true firebacks, as it has none of the fiery color on the back, this part being black, the feathers margined with brilliant blue, but the entire scapulars are a deep chestnut red. The rufous-tailed firebacks are the smallest species of the group, have no crests, and the females are also armed with sharp spurs. But little is known of the habits of these splendid birds, save that they frequent thick forests, go in small bands of five or six individuals, feed on berries, leaves, insects, and various grubs, are difficult to flush, but when on the wing fly rapidly and for a considerable distance, and are very pugnacious. Nothing is known of the nidification, but an egg obtained from a captured female of *E. vicilloti*, was large, smooth, and of a pale *café au lait* color. The Siamese fireback, *E. pralatus*, is a particularly graceful and beautiful bird. It has a long blue upright crest, the shafts bare of webs at the base; neck, breast, and back bluish-ash color, mottled with black; middle of back golden; rump and upper tail-coverts black, with blue and green reflections; the feathers margined with deep velvety crimson. The flanks and under

parts are black, glossed with deep blue; the tail and long coverts black, with blue and green reflections. The bare skin of the face is crimson; the legs and feet red. The silver-pheasants, of which the well-known *E. nycthemerus* of China is typical, are large birds with the entire upper parts and tail white, and all the feathers are more or less minutely mottled with black. The Chinese species exhibits more white than any of the others, and the two central tail-feathers are nearly pure white, the breast and under parts bluish black. Besides China, these birds are natives of Burmah and



FIG. 102. — *Euplocamus nycthemerus*, silver-pheasant.

various parts of India. They are forest-loving birds, ascending as high as three thousand to four thousand feet upon the mountains, apparently omnivorous, feeding upon insects, grain, seeds, etc., not gregarious, and when disturbed utter a peculiar clicking sound. They are pugnacious, and the males are continually fighting. The *E. lineatus* breeds in March, the hen

laying seven or eight pale-yellowish eggs, minutely pitted all over, in a slight hollow in the ground, thinly lined with leaves and a few feathers. The third division contains the kalij or kaleege pheasants, as the term is variously spelled. They inhabit parts of India, Nepal, Bhotan, Sikkim, Assam, Arakan, etc., are four species — possibly more — in number, with long pendant crests, upper parts of a generally glossy black plumage in some species, with the rump feathers margined with white; breast and flanks covered with buffy-white lanceolate feathers. One species, *E. horsfieldi*, has the under parts bluish-black, like the back. The tails are generally of a bluish-black color. These birds range from the foot of the hills to eight thousand

feet of elevation, are not gregarious in the sense of going in flocks, but three or four are often found together. The males are extremely pugnacious, and Wilson states that, having shot one, and while it was fluttering on the ground in its death-throes, another male rushed out of the jungle and attacked it with the greatest fury. Like many of this genus, the male kaleege makes a singular drumming sound with its wings, either for the purpose of attracting the females, or in defiance of its rivals, and a favorite method of capturing these birds is to fasten a live male in some open place, and imitate the drumming sound, when other males rush out to fight him, and are easily shot or caught in the snares set for the purpose. The general habits and



FIG. 103. — *Euplocamus melanotus*.

nidification of the kaleege pheasant are very similar to the silver pheasants and others of the same genus.

The genus *Lobiophasis* contains but one known species, *L. bulcheri* (the bird described afterwards as *L. castaneicaudatus*, being in immature plumage), and was created for the elegant pheasant obtained by Mr. Ussher on the Lâwas River in Borneo. This bird in many particulars is peculiar, if not, indeed, unique. There are two erect horns of nude skin behind the ears, and two smaller ones at the base of the nostrils, while two lobes hang from the angle of the bill. The plumage is metallic of various hues, and the tail is pure white, the feathers, thirty in number, are rather stiff, and the shafts bare of webs towards their extremities. The tarsi are spurred. The female is brownish chestnut, all the feathers finely vermiculated with dark brown. The tail is

moderately long, and possesses the unusual number of twenty-eight rectrices. The bare skin of the face is bright blue, with one small wattle at the occiput, and one at the chin. The tarsi bear indications of spurs.

The golden pheasant, noted for its brilliant colors and magnificent ruff, is the type of the genus *Thaumalea*. Three species are known, *T. picta*, *T. obscura*, and *T. amherstia*. They are all Asiatic so far as known, being natives of Thibet and China. It is difficult to conceive more gorgeously attired creatures than these birds, and it is



FIG. 104. — *Thaumalea amherstia*, Lady Amherst pheasant.

not easy to decide which should bear the palm for beauty, the golden, with its amber-colored crest, green metallic mantle, orange-red ruff tipped with deep blue, scarlet under-parts, golden yellow rump, and lengthened tail, or the Lady Amherst, with its crimson, white-tipped crest, pure white ruff margined with deep green, golden yellow rump margined with dark green, metallic green breast, and pure white under-parts, and the greatly lengthened tail with the median feathers light gray with bars of green and black mottlings. Not much has been recorded of the habits of these pheasants,

in spite of the fact that the *T. picta* has been so long known, and of their nidification nothing has been related. They dwell in thick woods on the mountains of moderate elevation, and are hardy birds, the Lady Amherst pheasant being indifferent to both cold and snow, and is omnivorous, like the domestic fowl. It is an extremely jealous species, and will not permit the golden pheasant, its only rival, to approach the bounds of its habitation. The two species are not met with either in the same valleys or on the same mountains. The *T. obscura* resembles the *T. picta*, but is a darker bird in all stages of its existence, and is stated to inhabit Japan, although it cannot be said that this country has undoubtedly been established as its habitat.

The genus *Phasianus* includes the typical pheasants, some sixteen in number. It has been divided into several genera, which have been adopted by some writers either wholly or in part, while other authors prefer to consider them as sub-generic distinctions. Thus *Calophasis* was proposed for *C. ellioti*, *Graphophasianus* for *P. scemmeringii*, *Syrnaticus* for *P. reevesii*, and *Catreus* for *P. wallichii*. The first of these, *C. ellioti*, is a most lovely bird. It is a native of the mountains near Ningpo, province of Che-Kiang, China, and has the sides and back of neck bluish-gray, graduating into white; chin and throat black; back and breast metallic golden; lower breast and abdomen pure white, flanks irregularly barred with black, white, and chestnut; under tail-coverts deep chestnut and black; upper scapulars black margined with white, forming a bar on the shoulder; lesser wing-coverts maroon chestnut, reflecting a fiery metallic tint, greater coverts deep chestnut with a black bar followed by a broad white tip, making a white band across the wing; lower back and rump steel-black barred with white, upper tail-coverts gray mottled with black; tail long and barred alternately with stone-gray and chestnut, the latter narrowly bordered basally with black; legs bluish-gray, armed with well-developed spurs; skin of face scarlet. The hen is very like a grouse in her coloring; with a black throat, this hue extending on to the breast, under-parts white; side of head reddish cream-color; upper parts yellowish and reddish brown, barred and mottled with black. An ally to this brilliant bird was discovered by Mr. Hume in Manipur. It has some of the markings of *C. ellioti*, but differs in the throat and upper breast, which is metallic blue-black, and in the under-parts, which are maroon chestnut with metallic crimson fringes to the feathers. The female has the neck, throat, and breast a dull pale sienna-brown, abdomen dingy pale ochraceous, upper parts and tail similar to the hen of the other species. It is not so handsome a bird as the *C. ellioti*, but nevertheless is remarkable for its peculiar coloration. They dwell in the dense forests and are very shy and difficult to shoot, but not much is known of their economy and habits. Japan produces a beautiful species, the *P. scemmeringii*, and a variety of it called *P. scintillans*, a most attractive species with a very long tail and a plumage generally of a metallic copper. Very little is known about these birds in their wild state, but in captivity they are pugnacious, the male frequently killing the female when confined in the same enclosure. Another gorgeous pheasant is the *P. reevesii* from northern China. This has a general golden yellow plumage, each feather barred with black; flanks white, the chestnut margin separated from the white by a black bar, the abdomen black. The tail is excessively long, the central feathers sometimes reaching five and six feet in length. They are grayish-white, margined with deep buff, and barred with black and chestnut. These feathers are sometimes worn by the mandarins in their hats. Reeves' pheasant is a large bird, and its flesh is white and very delicate. It is numerous in the Tung-ling or eastern burial-places of the Chinese emperors, situated northeast of Peking, and



FIG. 105. — *Phasianus reevesii*, Reeves' pheasant.

in other parts of northern China. The cheer or Wallich's pheasant, *P. (catreus) wallichii*, is a native of the western Himalahs to the borders of Nepal. It is a large bird, weighing from two pounds ten ounces to three pounds seven ounces. It has a lengthened dark-brown crest, upper parts yellowish-brown bound with black, a rufous rump, ashy breast, and rufous flanks barred with black. The tail is long and broad. The cheer is a local species, dwelling at from four thousand to eight thousand feet of elevation, and haunting grassy hills covered with oak and pine. During the day the birds remain hidden, coming out to feed at morning and evening. They run fast and lie close, and are difficult to flush. Both sexes crow, and may be heard, when engaged in this amusement, for a great distance. This pheasant feeds on roots, grubs, seeds, berries, etc., and roosts on the ground, all the members of a flock, numbering from six to a dozen individuals, huddled close together. It nests from April to June, the

eggs are small, of a pale stone color, with brownish specks towards the ends. A small group of green-breasted pheasants may be here noticed, consisting of three species; *P. versicolor* from Japan, *P. elegans* from Sze-chuen, China, and *P. decollatus* from Sze-chuen and Moupin. They are all species of beautiful plumage, the green hues with metallic reflections covering the entire under-parts of *P. versicolor*, confined to a broad band from throat to vent in the second named, the flanks being a rich chestnut; while the third, *P. decollatus*, has the green color restricted to the region of the abdomen, with the flanks golden yellow. In habits, so far as known, they resemble other members of this genus. The white-winged pheasants, of which the superb *P. insignis* and its hardly less beautiful relative, *P. mongolicus*, may be considered as typical, form another small group, distinguished by the presence of a more or less broad white ring around the lower part of the neck, beneath the rich metallic hues of the head and neck. They are natives of various parts of Asia, China, and the island of Formosa. They are met with in flocks of considerable size in the localities they frequent, and are one of the chief attractions for the table to the people inhabiting the countries in which they dwell.

The remaining species of the genus *Phasianus* are those without rings around the neck, the metallic hues of blue or green coming to the breast. This group embraces the well-known *P. colchicus*, or common English pheasant so-called, and the superb *P. shansi* from eastern Turkestan. The English pheasant was naturalized in Great Britain before the Norman Conquest, the earliest record being in the year 1059, when it was mentioned in a bill of fare now preserved in the British Museum. It was probably introduced by the Roman conquerors, who also brought the fallow-deer to Britain. Like all of this genus, these pheasants are lovers of thickets and forests, shy, and, when hard pressed, taking refuge in trees. They have a kind of one-syllable crow, by which, in the spring, the male summons the female into his presence. They are omnivorous, and the male does not trouble himself with nest-building or the care of the young.

The sub-family Meleagrinae comprises the turkeys. Some writers place these with the Guinea fowls in a separate family, MELEAGRIDE, but it seems that they should more properly be included as a sub-family of the Phasianidae, to the species of which they are allied by various characteristics. But three species are known, the North American bird, *M. gallopavo*, the Mexican *M. mexicana*, and the Central American *M. ocellata*. The habits of the common species are so well known that it is unnecessary to devote any space to them here. The Central American species is a bird of wonderful plumage, excelling the others — brilliantly metallic as theirs may be — by the extraordinary variety and splendid hue of its scintillating coloring. The bare head and neck is deep blue, covered with bright red warts; the wattle between the eyes is also deep blue ending in yellow; the upper part of the back feathers metallic green, succeeded by a line of black, and terminating with yellow; back and rump feathers blue, followed by black and tipped with red; greater wing-coverts deep red; flanks and lower parts black tipped with brilliant red; upper tail-coverts and tail-feathers light brown mottled with black, followed by a broad spot of deep blue margined on both sides with black, then a line of yellow and tipped with deep red; bill, legs, and feet red. All these bright colors are metallic, and as brilliant as those of the humming-bird. This species goes in small flocks, is never found in the dense forests, preferring districts where forests and open country prevail. The birds roost in trees, and the male struts in the same manner as the common species, and in other of its habits greatly resembles the *M. gallopavo*.

The sub-family *LOPHOPHORINÆ* contains three genera, *Pucrasia*, *Cerionis*, and *Lophophorus*. The species are inhabitants of India and Asia, and number about a dozen in all. The pucas or koklass pheasants, by which trivial name the members of *Pucrasia* are known, are found in India and China. They are chiefly remarkable for their long crests, the central one springing from the top of the head, and the narrow occipital ones, on either side, and, at times, these are elevated above the other. They have a general brown and gray plumage, marked in various ways with black, dark brown, chestnut, and white, with the breast and lower parts more or less covered with

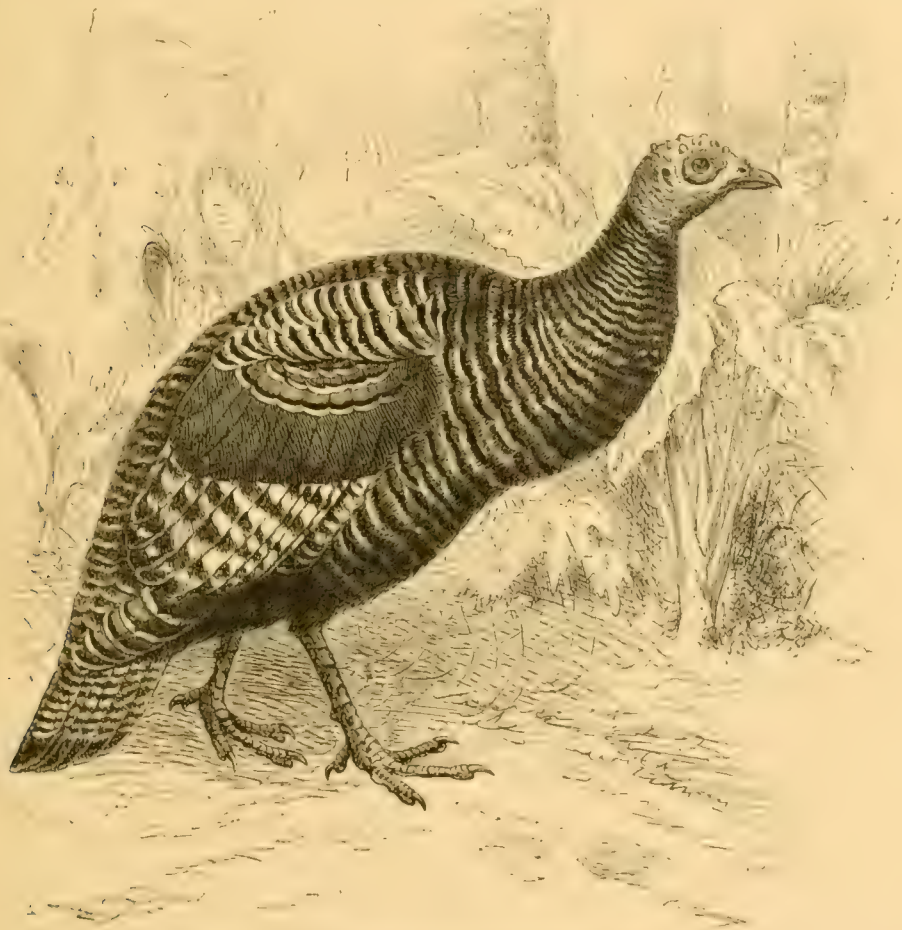


FIG. 106. — *Meleagris ocellata*, Central American turkey.

deep chestnut. They have broad cuneate tails, in one species at least (*P. darcini*) elegantly marked and striped in gray, black, and chestnut. The habits of *P. macrolopha* have been thoroughly described by Indian naturalists, and those of the other species, so far as known, closely resemble them. It is a forest bird, ranging from 4,000 feet to the extreme limits of forest on the Himalahs, is of rather a solitary disposition, generally found singly or in pairs, except when the members of a brood are together. When the cover is slight, it flushes at once or runs quickly, but otherwise lies close. The flight is extremely rapid, and the bird shoots down a declivity like

lightning. The males crow at daybreak, or at any sudden noise, like thunder or the report of a gun. The species feeds on leaves, buds, roots, grubs, acorns, seeds, berries, moss, or flowers, and grain, and roosts in trees or on low bushes. It nests at elevations of from 6,000 to 9,000 feet, the breeding-time lasting from April to the middle of June. The nest is a slight depression in the ground, and the eggs, seven to nine in number, are a rich pale buff spotted with deep brownish red. The species is believed to be monogamous.

The tragopans—by which name the members of the genus *Cerionis* are known—are five in number, and are found in India and China. They are birds of extreme beauty of plumage, presenting hues of the most brilliant reds, browns, buffs, and lustrous



FIG. 107. — *Cerionis satyra*, crimson tragopan.

blacks. The backs and breasts are usually covered with round white spots, like those seen in the Guinea fowl, or else with buff spots of various sizes surrounded with black. A fleshy horn, capable of being erected, and of various colors according to the species, exists on either side of the head; and on the lower part of the throat is an extensible wattle of brilliant colors, in some species deep blue barred with bright red, or yellow and shining green. When excited the males extend these gular aprons over the breast, producing for a moment a most beautiful effect. The best known of these birds are the Indian crimson tragopan, *C. satyra*, or the black-headed tragopan, *C. melanocephala*. They are dwellers of the higher ranges, and are found in summer at heights varying from 8,000 to 11,000 feet, are essentially forest birds, very difficult

to perceive in the thickets, in spite of their rich plumage, and, when disturbed, run swiftly to another cover. When roused by dogs, they fly into trees and call vociferously, but on man's approach they take flight, and do not alight again until a long distance has been traversed. In early spring—April—the males begin to call, inviting the females to some chosen spot. The nest is roughly formed of grass, small sticks and feathers, and the eggs are large and vary from a pale *café au lait* color, to a dull reddish-buff minutely speckled with a darker shade. One of the most characteristic points of these birds is the modes of 'showing off' adopted by the male. After walking about in an excited manner he places himself before the female, with the body crouching, and the tail bent down; the head is then jerked downward, and the horns and wattle become conspicuous. The wings have a flapping movement, and the neck appears to swell and the horns vibrate. Suddenly the bird draws himself to his full height, the wings are expanded and quivering, the horns are erected, and the wattles fully displayed. At other times he simply erects his feathers and elevates one shoulder, presenting a greater surface to view, but does not exhibit the wattles, and a third method is to stand on a perch, and, by shaking the head, exhibiting for a moment the horns and wattle. The other known species of *Cerionis* are *C. blythii* from upper Assam, *C. caboti* of southwestern China, and *C. temminckii* of central China.

A very curious bird was procured by Abbé David in Moupin, Thibet, and constitutes the sole known species of the genus *Tetraophasis*, and is called *T. obscurus*. Possessing the powerful bill of the members of *Lophophorus*, it has none of the brilliant colors of those birds, but is clothed in a plumage more like that of the snow-partridges (*Tetraogallus*), and would seem to be a connecting link with those species and the Phasianide. The sexes are alike, their dress being a combination of dark brown and gray, with a yellowish-white abdomen. It is rather a large bird of about twenty inches in length, and is common in the mountain ranges of eastern Kakonoor, goes in small flocks in the depths of the forests, and feeds upon roots which it digs up with its powerful bill.

The gorgeously plumaged species of the genus *Lophophorus* are three or four in number, *L. sclateri*, *L. lhuysii*, and *L. impeyanus*. It is difficult by means of a written description to give any idea of the magnificent appearance of these brilliant birds to any one who has not seen them. Their metallic hues of fiery red, green, purple, and gold vie in beauty and in their iridescent quality with the brightest of those seen among the humming-birds, and if one could imagine one of these small flying gems increased to the size of a fowl, something of the appearance of these monals might be conveyed to the mind. Selater's monal from Assam, and Lhuysii's from Thibet, are very little known, save that they inhabit the high ranges of mountains. The latter species, at about 14,000 feet of elevation, goes in small flocks and feeds on roots. The impeyan pheasant, which ranges throughout the Himmalehs, is well known, and its economy and habits are thoroughly familiar through the observations of many competent naturalists. In summer they ascend to great elevations, having been met with at a height of 16,000 feet, but in winter, when the snows are heavy, they descend sometimes as low as 4,500 feet, the females generally coming farther down than the old males. Occasionally they are found in considerable numbers scattered through the forest, the sexes generally by themselves, and if they pair, which is doubtful, the males leave the females and pay no attention to her while sitting, nor to the young when hatched. The call is a plaintive whistle, sometimes heard at all hours of the day. As a rule they are not wild save when much hunted, or in the spring, and when

in the forest will at once take wing, but in the open field usually walk or run to cover. They utter, when flushed, a succession of shrill whistles, and, on alighting, commence their plaintive call. They alight often in trees, and remain motionless, sometimes permitting a sufficiently near approach to be killed with a shot-gun. They feed on grubs or maggots, which they find under leaves, etc., and pass a great part of their time digging in the ground with their powerful bills. The flesh is delicate, similar to the turkey's, being especially well flavored in autumn and winter. Great numbers are killed for their skins, and in some places they have been almost exterminated in order to satisfy this pernicious demand of fashion in civilized lands. They breed at high elevations (7,000 to 12,000 feet), make little or no nest, and the eggs, four to



FIG. 108.—*Crossoptilon mantchuricum*, eared-pheasant.

six in number, are a dull white, speckled with reddish-brown. The sexes are entirely unlike in plumage, the female having none of the brilliant colors so characteristic of the male. The cocks weigh from four pounds six ounces to five pounds and a half; the females a little less. The crests of all the species of *Lophophorus* are different, that of the impeyan having the shafts bare of webs at the base, with metallic green spatules at the tips. *L. fluviisii* has a full, lengthened crest, metallic green with purple reflections; but *L. sclateri* has the top of the head covered with short, curly, recurved, green feathers. All of the species have the back of the neck brilliant metallic red, extending on to the back on the two last named, but changing in *L. impeyanus* in certain lights to a golden yellow.

The eared-pheasants of the genus *Crossoptilon* are four in number, and the females only differ from the males by wanting spurs. They receive their trivial name from

the presence of a band of white feathers which extends from the throat on both sides of the neck, and projects above and beyond the occiput like ears. They are large, graceful, and imposing-looking birds, very gentle and confiding in disposition, dwelling in the forests of the high mountain ranges of Thibet and China. The Chinese species are *C. manchuricum* and *C. auritum*; the first has the back and breast purplish black; rump and upper tail-coverts grayish white; flanks and under tail-coverts leaden gray; tail-feathers grayish white at the base, purplish blue at the ends. The other species has a general uniform ashy blue plumage; the middle tail-feathers are black, with green and violet reflections, the lateral ones white or nearly so, the end colored like the median ones. The Thibetan species are *C. thibetanum*, and *C. drouynii*, and have a general pure white plumage, with the crown of head velvety black. They differ from each other in the wings and tail,—the first having the secondaries dark lead-color, and the primaries dark rufous brown; while the tail is black, glossed with green, and with a white stripe on the outer webs of the lateral feathers. On the other hand the *C. drouynii* has wings grayish white, and the tail is dark gray, with the ends steel-blue, the central portions of the feathers having violet and coppery green reflections. The median rectrices of all the species have their webs very loose and long, and they fall over the other feathers on either side. The tail is carried in a drooping posture. There is also a nude crimson skin around the eyes of the four species.

For a long time a species of the genus *Argus* was supposed to exist, on account of some feathers in the Paris Museum, which resembled somewhat the long tail-feathers of the known species. Latterly, however, an entire specimen of the bird has been obtained from the interior of Tonquin, which shows that the species belong to a different genus, and the term *Rheinardius* has been proposed for it. The *R. ocellatus* does not possess the long secondaries, nor the lengthened median rectrices of *Argus*, but the tail is composed of twelve large, graduated feathers, and the head is not bare. The rectrices are dark, ash-gray, covered with large reddish spots with black centres, oblong in form, but lengthened into lines toward the margin of the webs. The feathers are very broad, graduate to a sharp point, and about four and a half feet long.

The true argus pheasants are so well known that a description of their plumage would be quite unnecessary. There are but two species, the common *Argus giganteus* of upper India, the Malay Peninsula, and Sumatra, and the *A. grayi* of Borneo. Nothing is known of the habits of the latter, but several competent observers have related some facts regarding the commoner species. Both sexes live quite alone, each male having a clear spot in the jungle, which he keeps scrupulously clean. These places are probably used for exhibition grounds, for the males at certain seasons strut after the manner of the peacock; but instead of the train, which the argus does not possess, the long wing-feathers are elevated, and the secondaries, with their numerous eyes or spots, are arranged in a semicircle, the spread tail filling the space between the wings completing the circle, and producing a very beautiful effect. They rarely fly, but escape by running and hiding, no difficult matter in the dense jungles they frequent. The females have no especial place of resort, but roam about the forest, visiting occasionally the male in his abode. The food consists of fruit and insects of various kinds. The female builds a rude nest, lays seven or eight eggs, said to be cream-color speckled with brown. The Bornean species is smaller, has a red breast, a black tail, and is differently marked on the wings and back.

The genus *Polyplectron* is so called on account of its members having several spurs

upon the tarsi. They are very beautiful birds, the feathers of the wings and tail being covered with ocelli of brilliant metallic colors, of blue, green, or purple, sometimes with red reflections. There are several species known, inhabiting Burmah, India, and the Malay countries, also in Cochin China and the islands of Sumatra, Borneo, and the Philippines. One species also is a native of Thibet. They are very shy and timid birds, frequenting dense jungles, through which they run rapidly, and hide and skulk so closely as to make it almost an impossibility to discover them. Some species are

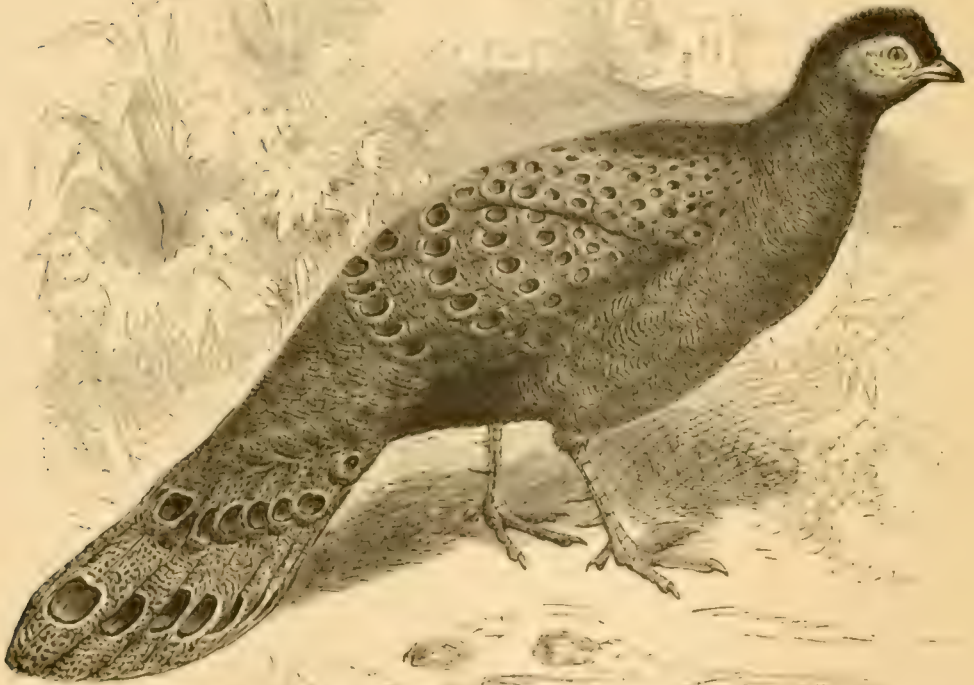


FIG. 102. — *Polyplectron bicalcaratum*, peacock-pheasant.

found on the mountains at elevations of 5,000 feet above the sea, but as a rule they are met with at more moderate heights. Not much is known of the nidification of these splendid creatures, the nest of only one species having been procured in the countries they inhabit, viz., that of *P. thibetanicum*, which was found in Cachar, and was placed at the foot of a large bush standing amongst grass and cane jungle. It was about nine inches in diameter and three inches in depth, made of twigs and leaves roughly put together, with a slight lining of the bird's own feathers. The eggs were a *café au lait* color. Two are generally the complement of a nest. The young are

covered with down, and follow the mother closely in search of food. She is accustomed to spread her fan-like tail, and the young keep beneath it and are thus protected from showers and enemies of the air, as they only appear when called to pick up some food the hen has found. The species known, beside the one already named, are, *P. bicalcaratum*, *P. germanii*, *P. helenæ*, *P. schleiermachi*, *P. chalcurum*, and *P. napoleonis*.

The genus *Pavo* contains the peacocks, of which there are two distinct species, and one which is very doubtfully distinct. The common species, *P. cristatus*, is known to everyone, and this gorgeous bird, so little appreciated because it is so familiar, is very plentiful in the forests and jungles, as well as in open places in India and Ceylon. It delights in hilly and mountainous districts, and it appears to be a curious fact that whenever peafowl are met with in the jungle, it is a pretty sure sign that tigers are in the vicinity. Whether the tigers rely upon the bird's ability to detect the approach of enemies, for they are very wary and always on the lookout, or whether the agile cat watches them in order to secure one or more for a meal, is unknown, but probably both of these suppositions influence the beast to seek the bird's resorts. The peafowl go in flocks, sometimes in very large numbers, and it is a beautiful sight when they take wing, their long trains glistening in the sun. The hens lay from April to October according to the locality, and the eggs, eight or ten in number, of a dull brownish white color, are placed on the bare ground in the most secluded part of the jungle. The young males retain a plumage like that of the hen for a year or eighteen months, and the train, which is composed of the upper tail-coverts, not the tail-feathers, is not perfected until the third year. Peafowl are omnivorous, and they eat insects, worms, reptiles, flesh, fish, grain, etc. The Javan peafowl (*P. muticus*) is, as its trivial name implies, a native of Java, but is not restricted to that island, being found also in the Burmese and Malay countries, Ceylon, and possibly Sumatra. It is a handsomer bird than the common peacock, having the crest, head, and neck rich green, and the breast bluish-green margined with gold. Its back is bright copper-color barred with green and light brown, and the upper tail-coverts are a rich green with gold and copper-color reflections. The train is similar to that of *P. cristatus*, but more bronzy in color. The two species resemble each other in their habits. A third supposed species, *P. nigripennis*, in appearance like *P. cristatus*, with black shoulders to the wings, is probably but a melanitic variety of the common bird.

SUB-ORDER II. — GALLINÆ-PERISTEROPODES.

The Peristeropodous Gallinæ comprises two families, the Megapodidæ and the Cracidæ, containing those gallinaceous birds with feet like pigeons, or all four toes placed upon the same plane, the hallux not being raised, as is the case with the species of the other families included in this order.

Two sub-families are generally acknowledged in the family MEGAPODIDÆ, viz., Megapodinæ, containing two genera and between twenty-five and thirty species, and Talegallinæ also with three genera and six species. The extraordinary method of nidification adopted by these birds is unparalleled in the whole range of Ornithology, and they are the first feathered inventors of an artificial incubator to take the place of the mother, and provide the warmth necessary to develop the embryo contained in the egg into the perfect chick, which is ordinarily supplied by the parent's body. The Megapodes are usually rather small birds, but with enormous feet, and dwell in

the thick brush near the sea-shore. Some species go in large flocks, the *Megapodius nicobariensis* having been met with in coveys of from thirty to fifty, but the majority of this genus are more usually met with in pairs and in quite small parties. They are natives of Australia, New Guinea, the islands of the eastern archipelago, and of the Pacific Ocean. As their habits and economy are generally alike, a description of those of *M. tumulus* from Australia will answer for all the species of the genus.

The Australian megapode is accustomed to seize with his foot a mass of soil, dead leaves, and other kinds of vegetable matter, and with a powerful kick backwards throw it to a common centre. The males assist the females in the operation of building the mound. By the constant accumulation of soil, and vegetable refuse, a conical mound is built, and this is added to year after year by the original builders, or others, perhaps their descendants, until they grow to a size that is almost incredible. One, the largest that seems to be on record, was situated on the island of Nogo in Endeavour Straits, and measured no less than 150 feet in circumference; and to form this huge accumulation of materials the ground had been scraped bare in the vicinity, even some shallow excavations having been made. The larger end was elevated 14 feet above the ground, and the slope measured in different directions 18, 21½, and 24 feet. Usually these mounds are formed of a light vegetable soil, but occasionally they consist of sifted gravel intermixed with portions of soil and decayed wood, and are generally conical in form; but one specimen was described as resembling a bank from twenty-five to thirty feet in length, with an average height of five feet. Some of these mounds are doubtless very ancient, and trees a foot in diameter have been found growing from the centre of the mass. After a mound has been constructed, or an old one rebuilt and arranged to suit them, the eggs are laid at a depth of five to six feet from the surface, the hen scratching a hole in the vegetable matter for the purpose. It is then covered and left. The eggs are always deposited at night, and the holes in which they are placed generally run in an oblique direction so that they are nearer the side of the mound than they are to the summit. The exact number laid by a hen is not known, but four have been taken at one time. After the hen has laid her complement of eggs, they are left to be hatched by the heat of the decomposing mass, and the chick appears fully feathered and able to fly. How the young make their way to the surface is a mystery, but once out they can take care of themselves very well. At first they remain about the mound, but in a few days they may be found a long distance from it, and if disturbed they run off, or fly into some tree for refuge. These mounds are always constructed in some dense thicket, never in the open field, and it can generally be known when a bird has visited any one of them by the tracks left upon its sides. The megapode never goes far inland, keeping about the beach or along the banks of creeks. It feeds on roots, which it scratches up with its powerful claws, seeds, berries, and insects. It is very shy and rarely seen. The flight is heavy and not continued, and generally, when disturbed, the bird takes refuge in a tree. At night they keep up a noisy cackling, and utter a hoarse note during the day. The eggs are white, but after being deposited, a crust, colored somewhat according to the soil in which it is placed, forms upon the shell, which, however, readily chips off. They vary in size, but are about 3¼ by 2½ inches, and both ends are equal. The Australian megapode is about the size of a common fowl. They possess a complete, thick, and muscular gizzard. The Nicobar megapode, *M. nicobariensis*, seems to differ slightly in certain of its habits from the Australian species, for the natives state that a pair and all its progeny use and add to a mound year after year,

and that out of one of these, about five feet high and sixteen or eighteen feet in diameter, as many as twenty eggs had been taken in one month.

Leipoa ocellata, the other generic form of this sub-family, also possesses this curious habit of mound-building, but the eggs are deposited in a very different manner from that related of the Australian megapode. Instead of being placed in holes in different parts of the mound, they are laid in the centre, all at the same depth and arranged in a circle about three inches apart, with the small end downwards, and eight eggs are about the largest number in one nest. The mounds of this bird are also constructed somewhat differently. A hole is first scratched in the soil, and this filled with dead leaves, grass, and similar materials, and then a huge mass of a similar substance is raised about it. Over this a quantity of sand mixed with dried grass is thrown until the whole assumes the conical form. When an egg is laid, a receptacle having been made for it at the edge of the hole in the centre, it is at once covered up. A second is laid on the same plane, but on the opposite side; the third is placed at the third corner, and the fourth opposite to it, and then the succeeding ones in the interstices left, so that the complement forms a circle. The young are said to dig themselves out, and the mother, who is always near, takes entire charge of the brood, the young remaining with her until half grown. The *Leipoa* is a slender and rather gracefully formed bird, with short legs and is about twenty-four inches in length.

The sub-family *Telegallinæ* has three genera, *Megacephalon*, *Talegallus*, and *Aepyodius*, the first with one species, the second with four, and the last with two. The interesting bird known as *Megacephalon maleo* is a native of Celebes, and is confined to the littoral parts of the island. It abounds in the forests, and feeds on fruits, descending to the sea-beach in the months of August and September to deposit its eggs. This bird does not raise a mound as the megapodes do, as its feet are not formed for grasping, and the claws are short and straight, but it excavates holes in the sand four or five feet in diameter, and in these, at a depth of one or two feet, the eggs are deposited. There are sometimes as many as eight eggs in one hole, each laid by a separate bird. The eggs, for the size of the species, are enormous, being 4.3 inches long and 2.4 inches wide, and of a pale brownish red. The egg quite fills the lower cavity of the bird's body, and about thirteen days elapse between the laying of each egg. After they are all deposited, the hen pays no further attention to them, and the young, on emerging from the shell, dig themselves out, and run off into the adjoining forest. The maleo is a handsome bird, the upper parts and tail being glossy black, and the under parts rosy white. The head and neck are bare, and on the head is a kind of helmet formed by the backward prolongation of the cranium into a cellular mass.

The four species of *Talegallus* are the well-known *T. luthami* of Australia, and the *T. curieri*, *T. jobiensis* and *T. fuscirostris* of New Guinea and some of the other islands of the eastern archipelago. They construct mounds similar to those of the megapodes, but several females deposit their eggs together, and it is said that nearly half a bushel of eggs have been procured in the same mound. The natives state that the mound is always opened by the male when the hens desire to lay, and the eggs are placed in a circle with the thin end downwards. When stalking about the woods the talegallus utters a loud clucking noise and runs rapidly through the brush when disturbed, or takes refuge in a tree. It is nearly as large as a female turkey, and has the upper surface, wings, and tail blackish-brown; under surface blackish-brown, the feathers silver-gray at the tip; skin of the head and neck deep pink red, sprinkled with short, blackish-brown feathers; wattle, bright yellow. The female resembles the

male, but is smaller. The third genus, *Æpypodius*, has two species from New Guinea and Waigu; but little is known of them.

The second family of this sub-order is the CRACIDÆ, divided into three sub-families, with between fifty and sixty species. They are inhabitants of the tropical portions of the New World, and although there is no important difference in their osteological structure and that of the Megapodidæ, they are entirely different in their economy



FIG. 110. — *Talegallus latham*, brush-turkey.

and habits. While the megapodes are terrestrial birds, passing the greater portion of their existence upon the ground, the Cracidæ are essentially arboreal, build nests in the trees, and incubate their eggs like true birds.

The first sub-family, Oreophasinæ, with its single species, *Oreophasis derbyanus*, is a native of Guatemala and the woods of the Volcan de Fuego to a height of 10,000 feet. It is apparently rare even in the localities it frequents, and not much is known of its habits, beyond the fact that it frequents the upper branches of the forest trees,

searching for fruit, which it eats whether ripe or unripe, and, as the day advances, descends to the under-wood, where it remains scratching among the leaves. It is a very handsome species, having the upper parts black, with blue reflections; a broad white band across the middle of the tail; breast white, striped with black; throat, abdomen, and thighs black; the bill yellow; a vertical, moderately-high helmet, composed of bony tissues, upon the top of the head, is red, as are also the legs and feet. The female is like the male, but smaller.

Penelopinae contains seven genera, *Ortalis*, *Chamaepetes*, *Aburria*, *Pipile*, *Penelopina*, *Penelope*, and *Stegnotama*. This sub-family contains among its species the smallest of the Cracidae, and they range in total length from sixteen inches to twenty-six inches, those of the least size belonging to the genus *Ortalis*. They are found from southern Texas through Mexico, Central America, and South America to Paraguay. They are graceful birds, with long tails and variegated plumage, with bare skin on the throat or around the eyes, or both, and the heads decorated in certain species with various kinds of crest. Like all of the Cracidae they are forest birds, dwelling much upon the trees, and descending to the ground in search of food. *Ortalis vetula* has been procured in Texas, and has been remarked for its loud and peculiar cry, which in harshness and compass is fully equal to that of the Guinea fowl. At sunrise the male, on descending from the tree where he has passed the night, mounts upon some old log and commences his clear cry, which is taken up by the female, and so one pair after another join in the chorus, until the whole woods ring with their voices. After this morning song of praise has terminated, the birds separate to seek their early meal. If surprised when thus occupied, they fly into the trees and salute the intruder with many croaks. The seven or eight white eggs are deposited in a nest on the ground at the root of a tree or side of a log, where a hole has been scratched several inches deep. This is lined with leaves, and the eggs are always carefully covered when the hen goes away for the purpose of obtaining food. The *O. leucogastra* is abundant in parts of Central America, and makes its nest of twigs, in a low bush; the young run as soon as freed from the shell, and, clinging to the branches of the underwood, are very nimble and difficult to capture.

The species of *Chamaepetes* have the throat feathered, the circle of the eye and the lores are, however, naked. It is said that *C. unicolor*, when flying in a downward direction, produces a loud rushing noise similar to the drumming sound of the snipe, when, after rising to a great height, it descends towards the ground with great velocity on stiffened wings. The single species of the genus *Aburria* is a dark-green bird, with copper reflections on its plumage, and is remarkable for the pendant wattle at the lower part of the throat. It is a native of New Granada. The members of the four other genera are rather large birds, the throat of most of the species being destitute of feathers, and the skin dilatable; the plumage is bright, or of a quasi-metallic coloring, and tails are long and ample.

The last sub-family, Cracinae, contains the curassows, large, handsome birds, dwellers in the thick forests, where they rest and roost upon the highest limbs of the trees. There are four genera, *Pauris*, *Mitua*, *Nothocrax*, and *Crax*, the various sections distinguished by certain characteristics, such as a bony helmet, swelling at the highest point into a club shape, and rising over the base of the bill and forehead, but no crest, seen in the first-named genus; a swelling of the base of the culmen, and a short, feathery crest, witnessed in *Mitua*; a bare loreal space and straggling, thin crest, extending from the forehead down the back of the neck, of the single species of *Notho-*

craz, and the full-feathered recurved crest, swollen culmen, and fleshy wattles pendant from the base of the mandible of the species of *Craz*. The plumage is mostly black and white; the females, when they do differ from the males, which is but seldom, being generally rufous on the underparts, with the back and wings mottled with light brown or white. The curassows inhabit Central and South America, only one species, *Craz globicera*, being found north of Panama, ranging into western Mexico. *Nothocraz urumutum* is said to have one habit which causes it to differ from all other members



FIG. 111. — *Craz alector*, crested curassow.

of the sub-family, and one which makes the bird extremely difficult to capture, and this is, its custom of living in burrows or holes in the ground. The natives state that it remains in its place of concealment during the day, coming out at night and ascending to the top branches of the loftiest trees in search of food. The Indians take up their positions in the forest where they first hear the birds, remaining all night, and shoot them just before sunrise as they descend to return to their underground abodes. All the curassows have very gentle and confiding dispositions, are easily tamed, breed well in captivity, and in their native countries are frequently kept by the inhabitants

and allowed to run with barnyard fowls. They go in considerable flocks; their nests are large and rather clumsy affairs, built of sticks, leaves, and grass; the eggs are white and rather large; and the birds themselves are much sought after for the table, as their flesh is delicate and palatable, similar to that of the turkey. With this group the list of the species properly considered as belonging to the order Gallinæ ends. The species, as will have been observed, are very numerous and of great variety, and form one of the most — if not, indeed, the most — important group of birds in the entire range of ornithology.

ORDER XIII.—PTEROCLETES.

The sand-grouse, which form this order, have usually been included by naturalists in the order Gallinæ, but the obvious impropriety of this has at length been conceded, and they are now elevated to a distinct order, lying between the Alcedoromorphæ on the one hand and the Peristeromorphæ on the other. They resemble the first of these great groups in their skull, palatines, maxillo-palatines, and bill; and the second in their pterygoid and basipterygoid processes, sternum, furcula, coracoid, and forelimbs. The feet, with its short hallux, entirely wanting in *Syrnhaptes*, and the short tarso-metatarsus, are very unlike a pigeon's. The vocal organs are pigeon-like; the trachea is cartilaginous, with a pair of laryngeal muscles at its bifurcation; but the crop, gizzard, gall-bladder, and small intestines are like those of Gallinaceous birds. The *cæca coli* are voluminous, and have twelve continuous longitudinal folds in their mucous membrane. The pterylosis differs somewhat from that of the pigeon. The lateral neck-spaces reach only to the beginning of the neck; the superior wing-space is absent; the lumbar tracts coalesce with the posterior part of the dorsal tract, and the latter joins the plumage of the tibia. The sand-grouse possess an after-shaft on the contour feathers, thus differing from the pigeons, and, unlike the Gallinaceous birds, have a naked oil-gland. In some characters these birds are plover-like, but they drink like a pigeon, thrusting the bill up to the nostril into the water, and retaining it there until the thirst is satisfied.

The family PTEROCLIDÆ is composed of two genera, *Pterocles* and *Syrnhaptes*, the species of which resemble each other in their general shape, having a rather heavy body, long, pointed wings, and extremely short legs and toes. They are awkward birds upon the ground, but move rapidly and gracefully on the wing. *Pterocles* has the tarsi feathered in front, and in *Syrnhaptes* both tarsi and toes are completely covered with feathers. In the osteology of these genera considerable differences are observable. The skull of *Syrnhaptes* is more pigeon-like than *Pterocles*; the upper frontal region is narrower between the eyes, and the alæ of the ethmoid are less swollen between the crura of the nasal. In *Pterocles* the bones of the face are strong like a pigeon's; the lower jaw bends farther back; the postorbital and squamosal processes and the malar arch are also stronger. The scapula is grouse-like, and there is one more caudal vertebra than in *Syrnhaptes*, and the styliform and sacral ribs have no appendage, but both genera have a rudiment attached to the last hæmapophysis. The sternum of *Pterocles* has the episternum and hyosternal processes as in *Syrnhaptes*; but the external hyposternal processes are shorter. The species of sand-grouse are inhabitants of Asia, India, and Africa, especially of the last continent, where twelve of the sixteen or eighteen recognized species are found. *Pterocles* comprises the great majority of known forms, *Syrnhaptes* having only two species.

They have a very beautiful plumage, the back generally mottled with brown, black, yellow, white, or rufous; the breast sometimes barred with black, white, red, or rich buff, and the lower parts deep buff, chestnut, black, or barred with black and white. *Syrrhaptes* differs in the feathered tarsi and toes, as already mentioned, in the extremely lengthened pointed wings, the first primaries of one species, *S. paradoxus*, being attenuated, and the median rectrices of both species are lengthened and filamentous. They are both Asiatic birds, but in 1863 great numbers of *S. paradoxus* suddenly, from some cause never explained, invaded Europe and proceeded as far as Ireland in the west, the Faroes in the north, and Perpignan in France on the south. In and about Pekin and Tientsin they go in flocks of many hundred individuals, flying swiftly



FIG. 112. — *Pterocles alchata*, sand-grouse

like plover, and, although shy when on the ground, yet on the wing will pass within a few yards of an observer. When flying, the species utters a note resembling "*truck turuck*," and, like all of the family, are accustomed to visit certain drinking-places every morning and evening. They feed chiefly on seeds, and deposit their eggs in the sand. The female does not sit very closely, and leaves her eggs exposed to the weather when she goes to drink, for these birds cannot exist long without water. The other species, *S. thibetanus*, resembles its relative in its habits, is a native of Thibet, as its name implies, and, when flying, utters a cry like "*caga caga*."

The species of *Pterocles* resembles also very much, in their economy and habits, those of the species of the genus *Syrrhaptes*, frequenting sandy tracts, sometimes in

bush or tree-jungle, and in Africa, the great desert of Sahara or other similar regions. Some exhibit considerable pugnacity, the males continually skirmishing among themselves. The flesh is not very much esteemed, being generally dry and of little or no flavor. When approaching their drinking-places, they are very cautious, and circle about the water several times before alighting, and remain only a few moments. On such occasion, they sometimes congregate in many thousands, but disperse, after allaying their thirst, to seek for food. The eggs are usually cream-color, spotted with brownish, and three to ten in number. The young run from the period they emerge from the shell.

ORDER XIV.—COLUMBÆ.

The well-known birds, pigeons and doves, which constitute this order have such a characteristic physiognomy that any one, whether a naturalist or not, can at once accord them their proper designation. They are possessed of a moderate size, straight or slightly curved bill, the basal portion covered with a soft, fleshy membrane (this being frequently tumid or bulged into a prominence) in which the nostrils are situated. The apical portion varies much in shape among the different species, being slender or stout, slightly or greatly curved. The gape is wide. The wings are long and pointed in most species, only the ground-pigeons having short or rounded wings, and some have the first primary falcate or sickle-shaped; others again have this feather notched, as in the Falconidæ. The tail is even, rounded, or wedge-shaped, usually long, and contains from twelve to twenty feathers. The coloring of these retrices is frequently of striking contrasts, and they contribute greatly to the beauty of outline and general appearance of the birds. The eyes are large, set well back from the bill, and often of bright colors. The tarsi are short and stout, feathered in a few species, bare in the rest, and covered in front with small scales. The feet are rather large, the toes divided to the base, except in some arboreal species which have the outer toe slightly joined to the middle one; the soles are rather broad and flat. Pigeons also possess certain peculiarities in their internal anatomy to separate them from other orders, such as the narrow sternum, with two notches on each side, the outer one deep, the inner often reduced to a foramen, and they have a deep keel for the attachment of the large pectoral muscles. The furculum is flat and without appendages; the gizzard very muscular; intestines long and slender, with minute cæca. The crop is large and double, becomes glandular in the breeding season, secreting a milky fluid which moistens the food upon which the young are nourished. There is in some species no gall-bladder, but others possess it. The feathers, unlike those of the members of Rasores, do not possess the supplementary plume.

Pigeons are monogamous, both sexes occupying themselves with nest-building, incubation, and rearing the young. The nests are loosely constructed, and never more than two eggs are laid, always pure white in hue. The young are born naked, blind and helpless, and are assiduously cared for by their parents, who feed them with the moistened food from their crops. Pigeons eat fruit, seeds, and grain; and drink by a continuous draught, immersing the bill to the nostrils in the water. In this habit they differ from all other known birds. The lower larynx is furnished with two pairs of muscles, and the voice is soft and plaintive, either a kind of coo or a rolling whistle.

The birds of this order are found all over the world, most numerous in the eastern hemisphere, especially in the islands of the archipelagoes and in Australia. About

three hundred species are recognized, divided by some writers into many genera, all having agreeably colored plumage, and many are clothed in feathers of most brilliant and opposite hues, varied in numerous instances with bright metallic coloration. The general form of the pigeon is rounded and heavy for the size of the birds, the flesh plump and tender, affording excellent food for man. The order Columbæ may properly be divided into five families, — Carpophagidæ, Columbidae, Gouridae, Didunculidae, and Didiidae. The last differs in so many respects, however, that it might with some propriety be advanced to a sub-order. The Didiidae is first to be considered in reversing the arrangement given above, as in an ascending scale they occupy the lowest rank.

There are two authenticated species of the family DIDIIDÆ, representing, however, very distinct genera, viz., the familiar dodo, *Didus ineptus*, of the islands of Rodriguez,



FIG. 113. — *Didus ineptus*, dodo.

Bourbon, and Mauritius; and the solitaire, *Pezophaps solitaria*, also of Rodriguez and Mauritius. Both of these curious and gigantic birds are now extinct. A second species of dodo was described as *D. mazarenus*, from a metatarsal bone, but it is now considered, at least by some naturalists, doubtful if this remnant, although much larger than similar bones of *D. ineptus*, really does represent a distinct species. The dodo was a huge ungainly bird, incapable of flight, and weighing between forty and fifty pounds. It was quite abundant in Mauritius in the commencement of the 17th century, and great numbers were killed by sailors for food. The testimony given as to the quality of its flesh varies somewhat, but the ver-

dict would appear to be that it was not very palatable. A live bird was in London in 1638, and its portrait was taken by several artists, the pictures being preserved to-day in different museums in England and on the continent. In 1644 the Dutch introduced dogs and hogs into the island, and these, by destroying the young of the dodo, probably contributed greatly towards its extermination, and in 1693 or thereabout these curious birds became extinct. But few remains of the dodo are preserved, only one or two nearly perfect skeletons and a number of different bones, the majority of which were discovered in a small swamp in the island of Mauritius, called *la Mare aux Songes*.

From a careful study and comparison of these remains it is proved that this

species was most nearly allied to the pigeons of all known birds. Its general appearance is described by several of the early voyagers in their quaint manner, and Bontius writes of it as follows: "The Dronte or Dodaers is for bigness of mean size between an ostrich and a turkey, from which it partly differs in shape and partly agrees with them, especially with the African Ostriches if you consider the rump quills and feathers; so that it was like a pigmy among them if you regard the shortness of its legs. It hath a great ill-favoured head, covered with a kind of membrane resembling a hood; great black eyes; a bending prominent fat neck, an extraordinary long, strong, bluish-white bill, only the ends of each mandible are of a different colour, that of the upper black, that of the nether yellowish, both sharp-pointed and crooked. Its gape, huge wide, as being naturally very voracious. Its body is fat and round, covered with soft gray feathers after the manner of an ostrich; in each side, instead of hard wing-feathers or quills, it is furnished with small soft-feathered wings of a yellowish-ash colour; and behind the rump instead of a tail, is adorned with five small curled feathers of the same colour. It hath yellow legs, thick, but very short; four toes in each foot; solid, long, as it were scaly, armed with strong black claws. It is a slow-paced and stupid bird, and which easily becomes a prey to the fowlers. The flesh, especially of the breast, is fat, esculent, and so copious that three or four dodos will sometimes suffice to fill one hundred seamen's bellies. If they be old, or not well boiled, they are of difficult concoction, and are salted and stored up for provision of victual. There are found in their stomachs stones of an ash colour, of divers figures and magnitudes, yet not bred there, as the common people and seamen fancy, but swallowed by the bird; as though by this mark also nature would manifest that these fowls are of the ostrich kind, in that they swallow any hard things though they do not digest them."

The dodo laid but one large egg and the nest was only a heap of fallen leaves loosely gathered together. Sir T. Herbert, who saw this bird in 1625, was not in any way favorably impressed with it, as he says, "her body is round and fat, which occasions the slow pace, or that her corpulence, and so great as few of them weigh less than fifty pounds; meat it is with some, but better to the eye than stomach, such as only a strong appetite can vanish."

The 'solitaire' or 'solitary,' *Pezophaps solitaria*, was also of large size, somewhat taller than a turkey, and said to weigh forty-five pounds. Leguat, in his voyage to the East Indies, published in 1708, gives the following description of the bird. "The feathers of the male are of a brown-gray colour; the feet and beak are like a Turkey's, but a little more crooked. They have scarce any tail, but their hind part covered with feathers is roundish. Their neck is straight and a little longer in proportion than a Turkey's when it lifts up its head. Its eye is black and lively, and its head without comb or cop. They never fly, their wings are too little to support the weight of their bodies; they serve only to beat themselves, and flutter when they call one another. They will whirl about twenty or thirty times together on the same side during the space of four or five minutes. The motion of their wings makes then a noise very like that of a rattle, and one may hear it two hundred paces off. The bone of the wing grows greater towards the extremity, and forms a little round mass under the feathers as big as a musket ball. That and its beak are the chief defence of the bird. It is very hard to catch it in the woods, but easier in open places, because we run faster than they and sometimes we approach them without much trouble. From March to September they are extremely fat and taste admirably well, especially while

they are young. The female has a sort of peak, like a widow's, upon the breast (lego beaks), which is of a dun color. No one feather is straggling from the other all over their bodies, they being very careful to adjust themselves and make them all even with their beaks. The feathers on their thighs are round like shells at the end, and being there very thick have an agreeable effect." Another writer states that there is also a frontal band resembling black velvet. It laid one egg once a year, and lived on seeds and leaves of trees. Its flesh was good. In 1865 Mr. George Jenner procured a large number of bones of this species, eighty-one in all, in the caves on the island of Mauritius. They were apparently the remains of no less than sixteen or seventeen



FIG. 114. — *Didunculus strigirostris*, tooth-billed pigeon.

individuals and, from the disparity in size, were supposed to represent opposite sexes. They all appeared to belong to birds that had been eaten by men or quadrupeds.

The family DIDUNCULIDÆ possesses but one species, the curious bird known as *Didunculus strigirostris*, or tooth-billed pigeon. It is a native of the Samoan or Navigator's Islands, where alone it is found, and is known to the inhabitants as *mamu-mea*, or red-bird, from the chief color of its plumage, which is chocolate-red. It feeds on plantains and the fruit of a species of *Dioscorea* or yam, and is very shy and timid. It is a ground-dweller, roosting on stumps and bushes, and building its nests in such situations. Both sexes assist in the duty of incubation, and are so intent in this occupation that they suffer themselves at times to be captured by hand from the nest. The *Didunculus* is possessed of considerable power of wing, and flies through the air with a loud noise, which, as stated by one observer, is so great, when the bird rises,

that at a distance it might be mistaken for distant thunder. This species was supposed to be rapidly becoming extinct, as its terrestrial habits made it an easy prey to predatory animals, such as cats and rats introduced into the islands from European vessels; but late accounts state that it has changed its habits, feeding and roosting exclusively upon high trees, and is increasing in numbers. It is in this way, through the struggle for existence, that habits which have been transmitted from parent to offspring through unknown series of generations, are suddenly abandoned, and entirely



FIG. 115.— *Goura victoria*, crowned pigeon.

opposite ones adopted, that give the needed protection to life and continued prosperity, which the inherited methods no longer are able to secure.

The peculiar bill of this species, having almost the characters of a rapacious bird, is composed of a powerful curved maxilla; and a mandible provided near the tip with two or three deep indentations, causing the parts between to appear like teeth. Although generally stated by most writers to be a gentle, timid creature, hiding whenever possible in the darkest portion of its cage, yet one in the possession of the

Rev. S. J. Whitmee, a male, was very savage, ruffled its feathers, and tried to bite any one approaching it. He stated that he knew from experience that if it got hold of the finger it gave a severe grip. It was placed in a large aviary with other birds, and lorded it over the other inmates, only permitting them to feed when it had finished, driving them about in a very savage manner. Some later writers have considered that the proper position for this bird should be next to *Treron*, but as the reasons given do not seem to be thoroughly conclusive, it is best to leave it next to the dodo and its kindred, where the majority of ornithologists have, up to the present time, considered it should be placed.

The GOURIDE comprises the great ground-pigeons, the largest and finest of existing species. There are about six belonging to the genus *Goura*, known by the trivial name of crowned-pigeons, and remarkable for their great size and the high, open crest with which the head is ornamented. They pass most of their time upon the ground, walking in a majestic kind of way along the forest paths, flying, when disturbed, to the lowest branches of the nearest trees, in which situations they pass the night. They are natives of the Papuan Archipelago, where the absence of predatory animals and scarcity of large reptiles permit them to lead a comparatively secure life and breed unmolested in the localities they frequent. They feed on fruits, and lay two eggs; the nest is stated to be placed on the branches of trees. Some of the species have, at different times, been inmates of the aviaries in various zoological gardens, where they always attracted attention and admiration from their size, stately bearing, and the harmonious coloring of their plumage. The earliest known species is the *G. coronata*. Another even more beautiful is *G. albertisii*, from New Guinea, and *G. victoria* from Jobi and Misori.

The COLUMBIDÆ, containing those pigeons whose long tarsi fit them more for a terrestrial than an arboreal existence, and also the doves, comprises a great number of species scattered all over the world, divided by different authors into many genera, a large number of which can at the most only be considered of sub-generic value, and many as entirely unnecessary, being of no value at all. Thirty-nine may be considered as sufficiently established to require notice, and in this article a brief review of the species they contain will be given.

The first is *Otidiphaps*, a genus created for the beautiful birds from New Guinea and other of the Papuan Islands. Their exact position is not yet fully established, some authors having placed them, with an expressed doubt, however, in the family Didunculidæ, others in the Gouridæ. Of the two the latter is certainly more nearly correct, but it would seem that the great crowned-pigeons are sufficiently characteristic to stand in a family by themselves, and then *Otidiphaps* would occupy the position here assigned it at the foot of the present family. Three species of this genus are known, birds of considerable beauty of plumage and symmetry of form. They have been so lately discovered that very little has been recorded about them, only two or three Europeans ever having seen them alive. They are said to live in woods, feed upon fruits, and one (*O. nobilis*) is said to have a strong voice like a megapode. The flesh is white, tender, and most excellent for food. They are about eighteen inches in length, with a plumage of green and blue, metallic about the neck, and chestnut on the back. The tail contains the unusual number of twenty feathers.

The genus *Eurygon* has but a single species (*E. terrestris*), a native of Papua. It is a handsome bird with a rather strong bill, and a plumage of a general dark leaden gray. There is a white spot on the sides of the head; the back, rump, wings, and

tail, are shining grayish olive, sides and under tail-coverts rufous. It is a rare species in museums, but not uncommon in the localities it frequents.

Sternenas, the next genus, contains also but a single species, *S. cyanocephalus*, the blue-headed pigeon of Cuba, said sometimes to visit the Florida Keys. It is a handsome bird, of a general rich, chocolate hue, the top of the head bright blue, and the throat, blackish, bordered with white. It lives upon the ground. Another genus with a single species now follows, viz.: *Caloenas*.

The *C. nicobarica*, which by some authors has been considered as representing a separate family (called CALLENATHIDÆ), is remarkable for the long plumes, like hackles, which cover the neck and fall over the breast and back. It is widely distributed over the eastern archipelago, feeds upon the ground, and, although it flies heavily, yet is



FIG. 116.—*Sternenas cyanocephalus*, blue-headed pigeon.

capable of making very extended journeys, it having been captured at sea a hundred miles from New Guinea. Scattered generally throughout the Papuan Islands, it is nowhere very abundant, remaining mostly on outlying islets, where it would be free from the attacks of animals. This pigeon has bred in the aviary of the Zoological Society of London, a pair having taken possession of an artificial nest and laid one white egg, which, after having been incubated for twenty-eight days, produced a young bird, black and naked. On the feathers appearing, those of the tail were black and remained so, although these in the adults were pure white. This form was described as distinct by Gray as *C. gouldii*.

Six or seven species are included in the next genus, *Phægenas*; very attractive birds from the Papuan and Samoan Islands, among the most beautiful of which *P.*

johannæ and *P. stairii*, from the Duke of York and Samoan Islands respectively, may be named. All the species possess fourteen tail-feathers.

The members of the genus *Phaps* are confined to Australia, where they are known as the bronze-winged pigeons. They are distributed generally all over that continent; are fine plump birds, weighing about a pound apiece, and afford excellent food. They breed sometimes on the ground, sometimes in the fork of a tree, are exceedingly swift in flight, and are capable of traversing great extent of country, during the season of drought, in search of water, in a very brief period of time. The species, of which there are three, possess a very attractive plumage, and derive their trivial name from the lustrous coppery bronze spots upon the coverts of the wing. The tail consists of sixteen feathers.



FIG. 117. — *Callanenas nicobarica*, Nicobar pigeon.

Lophophaps and *Geophaps* are also also Australian genera, the first containing three, and the last two species. The members of *Lophophaps* are lovely birds, having, as their generic name implies, a long crest rising from the centre of the head, the back and wings being crossed with rusty-red and brown bands, and metallic bronzy-purple mark on the secondaries. They are small birds about eight inches long, congregate on the ground, and rise, when disturbed, like quails, plunging immediately in the long grass for concealment. The species of the other genus are larger birds, with peculiar black and white markings on the face and throat in one (*G. scripta*), and orange black and white in the other *G. smithii*. They are strictly terrestrial in their habits, and in their carriage and action similar to a partridge. They go at times in pairs, but frequently in coveys, and, when approached, run and hide in the grass. They rise with a loud noise and fly with great rapidity, taking refuge in the nearest tree. The eggs are laid on the ground, but no nest is made.

The genus *Leucosarcia*, also confined to Australia, contains but one species, a large handsome bird known as *L. picata*, remarkable for the delicacy of its flesh. It inhabits the brush which stretches along the line of coast of New South Wales, or that covering the hillsides of the interior. It passes its time on the ground, rising with the sudden burst and noise of a Gallinaceous bird, but does not remain long upon the wing. It has a very pleasing plumage of slate-gray and white. The tail has fourteen feathers.

Henicophaps, with its single species, *H. albifrons*, is a genus restricted to the Papuan Islands, but of a more extended distribution than some which are found in that archipelago. It is a rather dull-looking bird, with a strong plover-like bill; the



FIG. 118. — *Ocyphaps lophotes*, crested-pigeon, and *Phaps chalcoptera*, bronze-wing pigeon.

plumage fuscous rufous black, tinged with glossy green, the wing-coverts glossed with a golden-copper hue, forehead white. Very little is known of the bird. It was first procured by Wallace in Waigu, where it feeds from low trees and shrubs, but does not appear to be altogether terrestrial.

Chalcophaps is a genus of brush pigeons, containing about a dozen species, which feed upon the ground on seeds and berries. It is pretty widely dispersed, the species being natives of India, Ceylon, Java, Borneo, Australia, Papuan and Philippine Islands, and Formosa. They have a rich, glossy, mostly green plumage, and a very swift flight. The best-known species is probably the *C. indica*, found all over India where forests exist, and all countries to the east of the Bay of Bengal, also throughout the islands

of the eastern archipelago. The back and wings are emerald green glossed with gold; two dusky and two grayish bars cross the back and rump, and a white bar on shoulder of the wing. Beneath the body is vinaceous red-brown, with ashy under tail-coverts. This beautiful species feeds upon the ground, walks with a rapid gait, and is seen usually alone. Another very beautiful species of this genus is the *C. stephani* from Celebes and the Papuan Islands.

The genus *Petrophassa* contains a singular species, *P. albipennis*, an inhabitant of the rugged and desolate portions of the coast of northwest Australia, where it is common among the sandstone cliffs. It is a brown bird with black lores, and the basal half of the primaries pure white. Another genus with a single species is *Ocyphaps*, *O. lophotes*, also confined to Australia. It is a bird of much elegance of form, with a long slender black crest flowing from the occiput. Its dress is gray and olive-brown, with shining bronzy-green wing-coverts. Tail of fourteen feathers, the two centre ones brown, remainder brown, glossed with green and tipped with white. It dwells on the plains of the interior, assembles in very large flocks, and flies with a rapidity unequalled by any member of the group to which it belongs.

South Africa presents us with another genus *Tympanistria*, having but one species, the *T. bicolor*. This is a very pretty bird with fuscous-brown back and wings and white under parts. It is confined chiefly to the forest districts, and appears to have certain powers of ventriloquism, throwing its voice to a distance so as to deceive the hunter who may be standing under the very tree upon which the bird is perched. Another African genus is *Chalcopelia* with three species, the best known of which is probably *C. afra*. They are pretty little birds, the species just named being of a beautiful vinaceous color on the breast and lower parts, and with some large brilliant purple and green spots on the wings. It is common on the Okovango River, where it constructs a nest of a few sticks placed in a bush or low tree, and so loosely put together that the two white eggs may be seen through the structure by any one looking up from below.

Haplopelia was established for three or four species, two from Africa, and one from St. Thomas and Prince's Island respectively. The African birds *H. lavata* and *H. bronzinæ* are beautiful species with considerable metallic gloss of green and copper upon the plumage. They apparently prefer to keep in forests, feeding on berries, and are not uncommon. The bird from St. Thomas (*H. simplex*), as its name implies, has not so highly colored a plumage as its relatives. By some authors these birds are included in the genus *Peristera*.

We now come to a well-marked Central and South American genus with a few offshoots among the islands of the West Indies, viz., *Geotrygon*, with a little over a dozen species. They have a very stout form with a short rounded wing, the third quill longest, the others abruptly sinuated on the outer edge; the first quill sickle-shaped but not attenuated. These birds are from nine to twelve inches in length, of a very attractive and harmonious plumage, and excellent as food. In the island of Jamaica there are two species, known as 'mountain witch,' and 'partridge-dove.' They are essentially ground birds, feeding on seeds and occasionally on slugs. They frequent wooded parts of the country, and are wary and difficult to approach. In certain districts they are abundant, and the nest is a rude affair of a few dry leaves and twigs gathered together. Two beautiful species of this genus are *G. veraguensis* and *G. laurencei* from Central America.

Leptoptilu is another genus of about a dozen species, whose members have nearly

the same distribution as those of *Geotrygon*. They are birds of about the same size as those of the last-named genus, and of very attractive appearance. The single species from Jamaica, *L. jamaicensis*, is a very lovely bird, with a white forehead and blue crown, neck reddish-brown, changing to amethyst, the lower feathers brilliant green and purple. Under parts pure white, and a blue-gray tail tipped with white. It lives on the ground, has a plaintive voice (the negroes interpreting its cooing tones by the sounds "rain-come-wet-me-through"), and lives upon nuts and the seeds of the orange, mango, etc. It is very gentle, and, when flushed, only flies for a short distance, generally to the branches of some low tree. It builds its nest generally in a moderately high situation, and is known by the trivial name of "white belly."

Chamæpelis, with some half-dozen species, contains the ground-doves, little creatures which pass their time on the ground almost exclusively. The best known among them is *C. passerina*, from southern North America, Mexico, Central America, and Brazil. It goes in small groups of seldom more than a dozen, and prefers rather open places, runs with great facility, keeping the tail elevated. It is an extremely gentle bird, and readily becomes domesticated. It feeds on seeds of various grasses and berries. The nest is placed in low bushes, and is composed of twigs and lined with grasses. The flesh is excellent. The plumage is light, purplish-red on the neck, breast, and flanks, with a brownish gray back; the tail is gray at the base, bluish black towards the end, tipped with white. The female is similar to the male, but paler in tint. The *C. erythrorhax*, from Bolivia and Peru, has been placed in a distinct genus, *Gymnopenia*, on account of its nude orbits.

Columbula contains two species, according to some authors, confined to South America, resembling the ordinary dove in form, and are of a brown plumage, with lengthened tail. One (*C. campestris*), from the interior of Brazil, is a very graceful bird, with a vinaceous breast, olive-brown back, and the lateral tail-feathers black tipped with white.

Scardafilla has also but two species scattered over Mexico, Guatemala, and Brazil. They are known as the scaly-doves, from the distinct markings of the edge of their feathers, and are diminutive representatives of the wild-pigeon (*Ectopistes migratoria*), but do not possess the beautiful changeable hues that adorn the neck of that species. *Melopelia* and *Metriopelia*, both possessing two species, are New World genera, their species extending from Mexico southward, on the west coast of South America, to Chili. They are plainly clad but gracefully shaped birds, *Melopelia leucoptera* being characterized by a large patch of white upon the wing, from which it derives its name, while its relative, *M. meloda*, is dark blue around the eye. *Metriopelia melanoptera* has the wing blackish, with a white shoulder.

Zenaida, with some half-dozen species, is confined chiefly to the West Indies and South America, with one member from the Galapagos Islands. The most familiar species of this genus is probably the *Z. amabilis*, from the West Indies, occasionally seen upon some of the Florida keys. In Jamaica, where it is not uncommon, it haunts the open pastures, where any intruder can easily be discovered. It is wary and difficult of approach, and flies with great rapidity, making the peculiar whistling with the wings so characteristic of so many doves. It subsists on various fruits and seeds, and its flesh is white and much esteemed. The plumage is pleasing, though of sober colors.

Peristera, as restricted by some writers, is also an American genus, of some four species, found in Mexico and Brazil. The species have the usual coloring peculiar to

doves, *P. cinerea* being grayish blue on the head, neck, and back, and ashy white below. The tail is slightly rounded, with the lateral feathers black. It is found in Cayenne, Brazil, and Peru, also in Central America.

Turtur, to which we now come, is a rather extensive genus, containing something like twenty-five or thirty species. They are scattered pretty generally over the Old World, but the genus is not represented in the western hemisphere. The familiar



FIG. 119.— *Turtur vulgaris*, turtle-dove.

turtle-dove, *T. vulgaris*, is a representative species of this genus. Inhabiting Europe generally, it extends eastward into western Asia and southward into Africa. Timid and retiring in disposition, it is universally accepted as the emblem of peace, and lives in amity with all others of its race. While accustomed to frequent trees, it is also at home upon the ground, where it walks with ease. It flies with great swiftness, and turns and twists in its course with marvellous celerity, and pilots its way amid the forest, even when at full speed, with extraordinary skill. When mated, the pair evince

great affection for each other, and should one die, the survivor exhibits his sorrow by mournful cooing, and searches diligently for his companion. Like others of this group, the turtle-dove feeds on seeds of various kinds, and grain, and inhabits districts where fresh water is obtainable; always, when desirous of quenching its thirst, alighting near the water in some open spot, and then walking down to the edge of the stream or pond. The nest, a slight platform of twigs, is placed upon some convenient branch, on which the two white eggs are deposited.

A very pretty species of *Turtur* is the *T. semitorquatus* (separated by some authors in a genus, *Streptopelia*), from Senegal and the Gambia. The crown is bluish-ash, a black semi-collar on back of neck; under plumage vinaceous; belly and vent white; back, wings, and tail grayish-brown; a broad black bar crosses the tail, which is broad and rounded, with the basal half black. A close ally to this last is the *T. albiventris*, from South Africa, very similar in plumage, but with the outside tail-feathers white. This is a very abundant species, and bred, at least at one time, within the precincts of Cape Town.

Without any very technical distinctions the doves are a well-marked group, the chief character being the form of the tail. Their colors, though pleasing and harmonious, lack the brilliant and often bright hues of the pigeons. They have a graceful shape and small heads; the tail lengthened, rounded, or graduated.

Macropygia, containing about two dozen species, is confined to India, the Malayan islands, and those of the eastern archipelago, and Australia. The birds are distinguished by their long, broad tails, are fruit-eaters to a certain extent, but also feed on the ground, and in their color and general appearance more resemble doves than pigeons. The genus has been subdivided by various authors into several genera or sub-genera, such as *Coccyzura*, *Turaccena*, *Reinwardtana*, and *Streptopelia*, but for the present any consideration of these is unnecessary. The *M. reinwardtsi*, from the Moluccan and Papuan islands, is one of the finest of this group. It has the forehead and sides of the head, neck, and middle of the breast pure white, all the rest of head and body ashy white; back, scapulars, and two middle tail-feathers reddish-chestnut; primaries black; other tail-feathers are ash-color, with black bases, and a black bar near the tip. There is also a nude skin around the eye. Feet red. Total length about twenty inches. The general appearance of this bird is very handsome, and the long graduated tail gives a very graceful shape to the body. It is found in several of the Papuan and Moluccan islands.

Another, *M. modesta*, from Timor, is also a striking species of very different appearance from the one just described. It is, as its name implies, dressed in subdued colors, but there are, over the general leaden hue of its plumage, metallic reflections of green and purple. A lemon-yellow skin surrounds the eye, and the iris itself is red. *M. leptogrammica*, from Java, is very different again from both the species given, having the top of head and back or mantle metallic green with purple reflections; similar but brighter reflections are seen upon the throat and breast. The back, wing-coverts, rump, and the six large feathers of the tail are ferruginous, banded transversely with black. The other tail-feathers are ashy at their base, then black, and tipped with grayish blue; the tail is long and graduated; the throat and belly are pale lilac, and under tail-coverts red. The total length is fifteen inches. This species lives on the summit of high rocky elevations in wooded districts, and feeds on peppers and grain and various aromatic seeds, which communicate to the flesh a very agreeable taste, causing it to be highly esteemed for food.

The only member of this genus found in Australia is *M. phasianella*, which has a rich, rusty-brown plumage, with the sides and back of the neck glossed with bronzy-purple; the lateral tail-feathers crossed near the tip by a broad black band; the iris, blue, with an outer circle of scarlet; the feet, pinkish-red. The pheasant-tailed pigeon, as it is called, resorts entirely to the brush from Illawarra to Moreton Bay, where it is common. It spends much of its time on the ground, searching for seeds, usually four or five birds being in company. When on the wing, with its broad, lengthened tail spread to the fullest extent, it appears to the greatest advantage. It is of about the same size as the preceding species.

Geopelia, our next genus, is composed of about six species, four being natives of Australia, some of which, together with the remaining members of the genus, being found in different Moluccan and Papuan islands. In Australia they inhabit the hills and extensive plains of the interior, passing much of their time upon the ground. They are small birds, with a modest plumage destitute of metallic coloring. The tails are long and graduated, and they have rather lengthened legs, to fit them for their terrestrial life. The *G. humeralis* is one of the most elegant of these graceful creatures, and is extremely abundant at Port Essington, inhabiting swampy grounds and banks of running streams. Its food is seeds of various grasses and berries, and it is very gentle, flitting from one branch to another when disturbed. The head, sides of neck, and breast are delicate gray; back, wing-coverts, rump, and upper tail-coverts, brown; feathers of back of neck rufous banded with black on the ends; two middle tail-feathers, dark-gray, rest reddish-brown at base, and largely tipped with white. This is the largest species of the genus. *G. cuneata*, also from Australia, is a beautiful little species, which makes a frail but pretty nest from the stalks of flowering grasses, crossed and woven together. One was composed of a small species of *Composita*, and placed on the overhanging grasses of *Xanthorrhea*. This bird is called by the natives *men-na-brunka*, from a traditionary idea that it introduced the *men-na*, a gum which exudes from an *Acacia*, a favorite article of food of the aborigines. Another species, *G. maugei*, is found in the Moluccan and Papuan islands; it differs from the rest in having the entire under parts whitish, barred with black.

South Africa presents us with a distinct genus, *Æna*, containing a single beautiful species, *Æ. capensis*. The forehead, cheeks, chin, throat, and chest are glossy black; upper parts, ash-color; secondaries, bluish with a purple spot; wing-feathers, deep-red, edged with brown; a white bar extends across the rump, succeeded by a narrow black one; the tail is long and graduated. These birds are very abundant, and are chiefly terrestrial in their habits. In the Karroos they breed in the mimosa bushes. They generally go in pairs, feed on seeds, and the eggs have a rosy tint from the thinness of the shells. The young at first are mottled.

Zenaidura is well represented by its familiar species, the Carolina dove of North and Central America, the *Z. carolinensis* of authors. This bird is distributed throughout the United States, from the Atlantic to the Pacific, but does not pass further north on the eastern sea-board than southern New England. In its habits it does not differ from other dove-like species, save that its method of nesting depends somewhat upon circumstances; it deposits its eggs on the ground in many sections of the country, but in districts where many venomous reptiles abound, the nest is placed on cacti and thorny bushes, which afford such protection, by their numerous spines, that even snakes can hardly climb them. This gentle bird is a gleaner of the fields, doing little or no damage, but picking up such seeds and grain as may be on the ground. It

flies with great rapidity and power, and with a whistling sound of the wings, twisting frequently in its flight, and threading its way among the branches, whenever it enters the woods, with unerring certainty. It possesses a graceful form and a soft voice, and although no brilliant colors are seen on its plumage, its modest, quaker-like garb is very pleasant to look upon. Two or three other species of the genus have been described, some of doubtful value.

Next to this group comes *Ectopistes*, with its single species, the well-known *E. migratoria*, the wild or passenger-pigeon. At one time this bird was extremely common in North America, passing over vast portions of the country in flocks of such incredible numbers that they would obscure the sky, and take a long time, sometimes days, to fly by any particular place, notwithstanding the enormous speed with which they pursued their course. This rapidity of flight has been estimated to reach between seventy and a hundred miles an hour, and is an essential qualification for this species, for their numbers being so great, they are compelled to pursue a constant migration, as it were, in search of food, and it therefore is of prime necessity that they should be able to pass over a large extent of country in a short period of time.

Their form is most admirably adapted for aerial progression, being an elongated oval propelled by long, well-proportioned wings, moved by large and powerful muscles, and steered by a long, graduated, fully-equipped tail. The limits of this article do not permit any extended account of this bird, and therefore only a few words can be written of its roosting-places. These are generally in forests where the trees are large, and but little undergrowth occurs. These roosts have been known to extend for a distance of forty miles in length and several miles in breadth. The trees in this tract would be loaded down with nests, crowded closely together, so that large branches have been



FIG. 120. — *Ectopistes migratorius*, passenger-pigeon.

known to break and fall from the weight of the birds gathered on them. The flocks depart at sunrise and return at night, for they must go great distances to find food sufficient to supply their needs. The arrival of the great host is an impressive sight. Long before their crowded ranks appear, their approach is heralded by a sound resembling the rising of a gale of wind, increasing in loudness until the birds hurl themselves into their chosen nightly abode, when the din caused by the flapping of myriads of wings, the struggles for a place upon the trees, the constant change of position, and the crashing of overloaded branches, is so completely overpowering that not only the human voice cannot be heard, but even the discharge of a gun would pass unnoticed. At one time these roosts were not uncommon, but they are gradually disappearing, for the wild-pigeon, like all other game, from lack of wise and requisite protection in the United States, is being brought slowly but surely to its final extermination. Such is a brief and cursory review of one of the most extraordinary customs of this beautiful species. Lack of space compels us to pass on to the next genus of the family.

This is *Ianthanas*, containing eight or ten species; birds of rich and handsome plumage, having considerable metallic lustre. They are inhabitants of the Moluccan, Papuan, and Polynesian islands. One species, *I. ianthina*, found in Japan, is not unlike in plumage a species (*I. metallica*) from Timor. This last is remarkable for the metallic hues of its plumage, which are lustrous greenish-purple, with various brilliant reflections. Another species from the Fijis—*I. citiensis*—has the entire plumage bluish ash color, with a metallic purple lustre, changing to bright green on head and neck; the back, rump, and breast also metallic green, with the wing and upper tail-coverts edged and tipped with the same. The throat is white. This beautiful bird is not uncommon in the Fiji Islands, where it is seen in parties of three or four. It is about fourteen inches in length.

A species from several of the Papuan Islands has been placed in a distinct genus, and called *Gymnophaps albertisii*, on account of a bare space around the eye, large feet like *Carphophaga*, and some other characters. In some parts of New Guinea this species is rather rare, but small parties of eight or ten were seen on the Fly River. It is only lately that this bird has been brought to the notice of naturalists.

The last genus of the family Columbidae is *Columba*, formed by Linnaeus, and containing a large number of species found throughout certain portions of the Old and the New World. It is characterized chiefly by a moderate bill, with the basal half of the maxilla covered with a soft cartilaginous substance; the apical half hard, arched, and hooked at the tip. The nostrils are placed towards the middle of the bill, and the skin is swollen above them. The wings are moderate and pointed, the tail rather short, even, or rounded, the toes moderate and free at the base. The genus has been sub-divided by authors into many sections, but it is not necessary to notice these in this article. The birds of this genus go in flocks of various magnitude, sometimes performing migrations of more or less extent, according to the diversity of climate. They frequent woods and feed on acorns, beech-nuts, or seek grain in the cultivated fields. Some species again dwell among rocks, making their nests in holes or fissures in the sides of precipitous cliffs. There are many large and stately species comprised in the genus, and some of very beautiful and attractive plumage. Only a few can be noticed here. One of the best known is probably the *C.enas*, or stock-pigeon of Europe. It is about thirteen inches in length, of a general bluish gray plumage, with the sides of head and neck glossed with metallic green. Breast vinous red. It is a

graceful bird, walks on the ground with ease, and rises on the wing without much loud flapping. It will raise two or three broods in a season, placing its nest in the hollow of a tree, sometimes in rabbit-burrows or other convenient holes in the ground. Both sexes incubate and assist in rearing their young. It feeds on various grains and seeds, and when numerous is very troublesome to farmers.

A remarkably colored pigeon of this genus is *C. leuconota* from the northwest Himalahs. The back, neck, and rump are white; the top of head and ear-coverts



FIG. 121. — *Columba anas*, stock-pigeon, and *C. palumbus*, ring-dove.

ashy black, wings brownish gray, crossed with three or four dusky bars. Tail ashy black, crossed by a broad grayish white bar. This is the snow-pigeon and imperial rock-pigeon of sportsmen. It frequents rocky heights and sequestered valleys from an altitude of 10,000 feet to the snow level. It feeds in the fields, returning to the rocks to roost, and is shy and wary. *C. guinea* and *C. arquatrix* (sometimes placed in a genus called *Stictornis*), are African species of about twelve inches in length, the former with a cinereous or plumbeous plumage, with the neck, breast, back, shoulders and wing-coverts vinaceous, the latter spotted with white; the tail is black. It is a

rock-dweller, placing its nest in inaccessible places in caves and in the holes of cliffs. The other species has the forehead, chin, neck, and breast dark vinaceous, mottled with black; above dark ashy with a reddish tinge on back and shoulders, and a greenish hue on the tail. This bird congregates in great flocks, and feeds upon wild olives and berries according to the season. It breeds on trees in mountain ravines.

The white-crowned pigeon, *C. leucocephala*, from the West Indies and Florida, is a handsome bird, remarkable for the pure white of the upper part of the head. The general color is dusky blue, the top of neck behind chocolate brown, lower part green with gold reflections. They are shy birds, and breed on the Florida Keys among the mangroves, and occasionally descend to the ground. *C. fasciata* of western North America, extending southward into Central America, is a very fine species and common in California and other of the Pacific states. It is a forest-loving bird, congregates in immense flocks, some of which have been estimated to consist of a thousand individuals. It feeds on berries, acorns, etc., and, where the country is settled, on grain which they procure by visiting the stubble-fields. The band-tailed pigeon, as this bird is called, has the head, neck, and breast purplish-red, with a narrow white ring on hind neck. The upper parts are grayish-blue, as is also the tail with a black band near the tip. This bird is about sixteen inches long. Central and South America contain several species of this genus, of which *C. plumbea*, and *C. araucana*, may be mentioned. The latter is a very handsome bird from Chili, having the head, mantle, and under parts reddish-purple shaded with ash-gray; the back, rump, and upper tail-coverts lead-color. A white bar crosses the hind neck below the occiput, beneath which is a patch of scaly metallic feathers reflecting golden and purple hues. The tail is brown, with a broad black band near the tip. The length of bird is fourteen inches.

The next and last family is that one here called CARPOPHAGIDÆ. This is the same in the main as Treronide of many authors, and contains the fruit-pigeons. They are birds varying much in size, many of most beautiful plumage, consisting of strongly contrasted colors. The bill varies from stout to slender; the wings are long; the tail moderate, with fourteen feathers (one or two exceptions to this); the tarsi short, more or less feathered, with bare part reticulated; and the inner toe is slightly united to the base of middle one. The species of this family are found in India, Malayan Peninsula, China, Moluccan, Papuan, and Polynesian islands, Australia, and Madagascar.

The first genus claiming attention is *Alectonas*, containing four species, one of which, *A. nitidissimus*, is a bird of very peculiar and striking appearance. It is a native of the Isle of France, and has the head and neck covered with long, loose white feathers that fall over the breast and back. At base of bill and around the eyes is a bare red skin. Body dark violet blue. Tail and rump bright red. It is a very rare bird in collections, and but few Europeans have met with it in its wild state. Some young birds that were in captivity, never went on the ground unless obliged to do so, but showed a wonderful capability in stretching to a great distance from their perch, sometimes with their heads perpendicularly downward so as to pick a fruit from off the floor of their cage. Another beautiful species is *A. madagascariensis*, from Madagascar and the island of Nossibé. It is of a general indigo-blue color glossed with violet; the tail, which is rounded, is red; the eyes are encircled with a naked red skin; the feet are red. This bird dwells in the forest, frequenting the topmost boughs of the tallest trees. Its flesh is said to be inferior to that of other

pigeons. The first primary of the birds of this genus is distinguished by possessing a deep notch in the inner web.

We now come to *Treron*, including the green-pigeons. This is a well-marked division, containing a goodly number of species, of plump form, clothed in a green plumage varied with ash and maroon, with considerable yellow on the wings, and orange hues on lower part of body. The genus has been divided into many genera



FIG. 122. — *Alectranas pulcherrima*.

or sub-genera, but it will be quite sufficient to consider such species as shall be noticed under the genus above given. These birds go in flocks, and are stated to be continually climbing about the branches, when searching for fruits, like squirrels, and the strong muscles of the legs enable them to hang over and seize a fruit and then recover their position without difficulty. They are good for food, but have a tough skin. They are found in India and Malasia, Africa, Japan, Madagascar, China, etc. We have only space to notice one or two. *T. phainopterus* (placed sometimes in a genus *Crocopus*), is found over all Bengal and upper India, eastward into Assam. It breeds

in the wild jungles and thick, damp forests, feeds on fruits, and will readily eat plantains in confinement. The top of the head and side of the neck are ash-gray; the neck and breast bright yellow green; abdomen bright yellow in the middle; there is a pale yellow bar across the wing, the upper parts are green; the tail ash-gray above, tinged with green, under-coverts maroon with white tips. *T. sphenurus* has a wedge-shaped elongated tail, with the usual green plumage, but the breast is brightly tinged with orange buff. The male has a very agreeable note, prolonged and musical, having some resemblance to the human voice in singing. It is a native of the Himmalehs.

T. fulvicollis from Malacca and Borneo, differs from the other species by having the head and neck chestnut.

The genus *Drepanoptilus*, with one species, *D. holosericeus*, from New Caledonia, is remarkable chiefly for the peculiar shape of the tips of the wing feathers, which have the outer webs notched, and graduated to a point beyond the shaft and separate from the inner webs. The plumage of the species calls to mind that of the members of the genus *Ptilopus* in which this bird has been frequently included. The general color is green, throat white. Five silver-gray bars cross the wing, one reaching the back: a similar bar crosses the tail; a yellow band and



FIG. 123.— *Treron waali*, green-pigeon.

a black one traverse the breast. Middle of breast and abdomen greenish yellow; rest of under parts bright yellow. A peculiar character of this bird is found in the upper tail-coverts, which are very numerous and long, and regularly placed one over the other, causing this part to be unusually thick.

We now reach the great genus *Ptilopus*, containing between seventy and eighty species, or over one fourth of all known pigeons. The genus, like many others in the order Columbæ, has been divided into many genera upon various pretexts, more or less plausible, but none are of sufficient importance to make their retention necessary. The birds of this genus are dispersed throughout the islands of Java, Sumatra, Borneo, Philippines, Moluccas, Papuan, and the various archipelagos and islands of the Pacific



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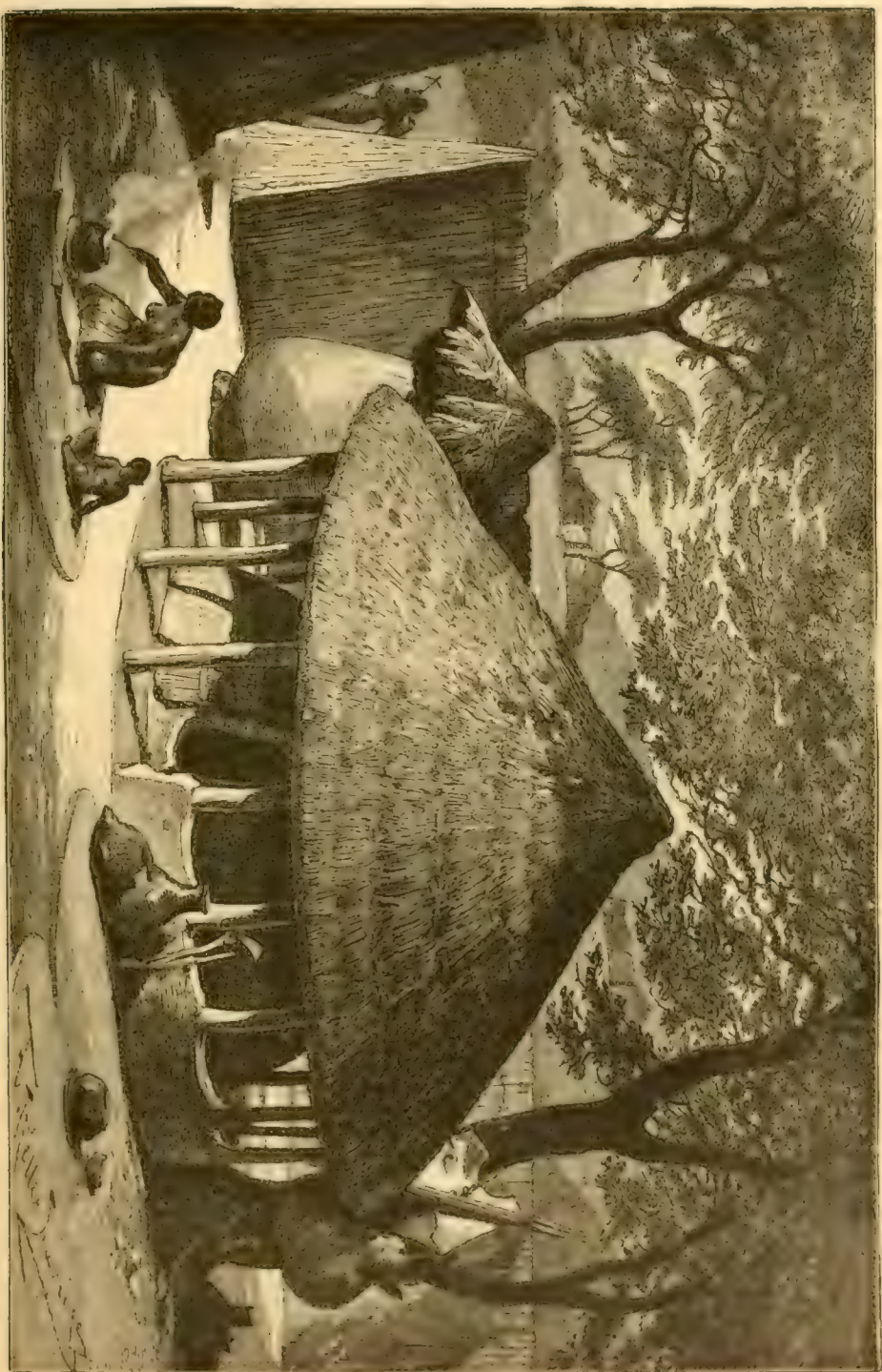


Begum of Bhopal with her daughter.





Chief of the Fans.



Betchmana house.



Beduin from Cairo.

Ocean as far to the eastwards as the Marquesas. Many islands have but one species, some contain a number, and the distribution of the different forms is often puzzling, sometimes almost inexplicable. But this is not the place to discuss the geographical distribution of any ornithological group, and we pass on to consider the plumage of these birds. This is most varied and attractive, the colors being so brilliant and contrasting in their different hues as to challenge admiration, and frequently to cause their possessors to appear among the loveliest of feathered creatures. The members of the genus have been divided into two great groups, distinguished by having the breast-feathers bifurcate and non-bifurcate. The first of them contains from twenty-five to thirty species, the second about fifty. Where all are so beautiful it is difficult to make selections to present as examples of the genus.

Among those separated as having the front and top of head purple or deep rose, margined with yellow or pale green, may be mentioned *P. roseicapillus*, from the Ladrone or Mariana Islands. It has the upper part of the breast grayish green, feathers tipped with pearly white; the lower part crossed by a green band, with a large, deep purple spot in the centre; abdomen orange, centre yellowish green; under tail-coverts bright yellow, rich orange at their tips. Tail pale green, tipped broadly with yellowish white. Another more beautiful is *P. perousei*, from the Samoan, Fiji, and Friendly isles. The forehead and crown and a broad band across the back are dark, purplish-red; head, neck, and throat, abdomen, flanks, and crissum yellowish white; feathers of breast split, rose-red at their base, rest yellowish white. Beneath these is a band of reddish orange; the under tail-coverts are dark, purplish red. The wings are pale gray; the tail grayish white. Bill and feet black. It is difficult to conceive a more beautifully arrayed creature than is this bird. It is about eight and a half inches in length. It dwells in the mountain defiles of the islands it inhabits, but is not abundant. The native name for it among the Fijis is *manu-ma*, shame or modest-bird. The young are so differently colored that they might easily be mistaken for a distinct species. Both of the above have the breast-feathers bifurcate.

Of the next group with non-bifurcate feathers, which has nearly double the number of members, the *P. insolitus* is remarkable for having the forehead and base of culmen covered by a large, bony protuberance, rounded in shape and red in color. The general plumage is a bright, bronzy green, with the abdomen deep orange-crimson, and the under tail-coverts bright yellow. This curious species is a native of New Ireland and Duke of York Island of the Louisiade archipelago. A very pretty species—the smallest of the genus—is *P. nanus*, with a general bronzy-green plumage, a gray band on each side of the breast, a purple spot in the centre of the abdomen, and all the wing-coverts tipped with yellow. It is from New Guinea and Mysol. *P. jambu*, from Malacca, Sumatra, Borneo, and Luzon, has the forehead, crown, and sides of face scarlet; the top of the head with an amethyst tint; the upper part of throat and chin black; the rest of under parts of body are white, washed with rose on the breast; the under tail-coverts deep chestnut; upper parts and wings dark green, as is also the tail, but with a gray band at the tip. Length, ten inches. This species is common in certain of the localities it frequents, and feeds on fruits, especially of the different species of *Ficus*. Another most lovely bird is *P. wallacei*, from the Aru and Kei islands; but probably the most brilliant of all, so far as color may be considered, is the *P. victor*, from the Fiji Islands. This feathered gem has the head and throat dull olive-green, and the entire rest of plumage bright orange-carmine; the tail is brownish orange, graduating into pure orange at the tip. This dove is said

to be the glory of the Fijian forests. It breeds in November and December, making a rude platform of small twigs for a nest, about ten feet from the ground, and lays two pure white eggs. It feeds on many kinds of berries and fruits.

One might go on indefinitely making selections from these lovely birds, but our limits forbid. It only remains to notice the bird which leads, through a chain of other species of *Ptilopus* that have not been mentioned, towards the genus *Carpophaga*. This species is *C. magnificus*, from Australia. It has two races representing it in certain of the Papuan Islands, and also in Australia at Cape York and Rockingham Bay. These differ from the species named mainly in size, the color of the plumage not being appreciably different. It has the head and neck greenish-gray, becoming light green on side of breast; the centre of throat and neck, breast and abdomen, deep purple; the lower part of abdomen orange-yellow; under tail-coverts yellowish-green; wings, back, and tail green, and a yellow bar across the wing. The total length varies from thirteen to nineteen inches. This fine bird dwells in the brush in various portions of Australia, is very shy and retired in its habits. It feeds upon the wild fig and the fruit of the palms, and possesses a loud, hoarse, monotonous note (frequently uttered by the male in the breeding-season), which is entirely unlike that of any other bird. The sexes resemble each other in plumage.

Another Australian genus is *Lopholaimus*, having but a single species, *L. antarcticus*. This is a very fine, large bird, remarkable for the thick double crest with which its head is adorned. In its habits it is strictly arboreal and gregarious, going in flocks of many hundred individuals, and descending upon the trees which bear its favorite fruit in such multitudes as often to break the branches by their weight. Its flesh is rather coarse and dry.

The last genus which calls for notice is *Carpophaga*, containing thirty or forty species of large size, some of which are among the finest of this family, having many rich and metallic colors on the upper part of their plumage. The feathers of the forehead advance on the soft portion of the bill, and the tarsus is short, and the feet broad, enabling them to grasp firmly the branches. Some species, separated by certain authors as *Globicera*, have a fleshy knob on the base of the bill, which is most largely developed during the breeding season in the male sex. Their distribution is very similar to that of the members of *Ptilopus*, being found on many of the islands of the various eastern archipelagoes. A very large species with a powerful bill, from the Marquesas, was described as *Serresius galeatus*. A group characterized by a black and white plumage have been united by some writers under the term *Myristicivora*, but with the exception of having a rather short tail, they differ from other members of *Carpophaga* mainly in the coloring of their plumage, hardly a generic quality. Others again have been distinguished by the various terms of *Phanorhina*, *Ducula*, *Zonanas*, etc., but these, like the various divisions of the other genera already noticed, can at most only be considered as indicating sub-generic sections of *Carpophaga*, useful, possibly, in grouping the species together, but not possessing characters of sufficient importance to cause them to stand apart by themselves.

A fine Indian species is *C. sylvatica*, with the head, neck, and under parts pearl-gray, tinged on the crown with vinaceous, the entire upper parts and tail shining coppery green; under tail-coverts deep chestnut; chin and orbital feathers white; bill red at base, bluish white at tip, irides and bare skin around the eyes crimson; legs lake-red. It is about nineteen inches in length. This fine bird is found in forests at low elevations, associates in small parties in search of fruits, and visits the salt swamps

on the Malabar coasts in search of the buds of *Aricennia* and similar trees. Its call is a deep moan, likened by one writer to the croaking of a bull-frog, but said to be somewhat ventriloquial. Its flesh is excellent. *C. bicolor*, from Australia, various Papuan, Moluccan, and Malayan islands, one of the white and black plumaged birds, is met with in great numbers in Australia wherever the wild nutmeg is found. It flies rapidly, and usually at such a height as to be beyond the reach of a gun. It is said to lay only one egg. *C. pacifica*, from various islands of the Papuan and Polynesian archipelagoes, is a fine species, with the head and back of neck ash-color; chin white; throat and lower parts of body vinaceous; upper parts shining green with golden reflections; under tail-coverts chestnut; bill with a round elevated knob at the base black. This bird is very common in the Samoan Islands, wherever fruit or berries are found. Many are caught alive and tamed by the natives, who esteem them highly as pets, and carry them about in their canoes tied to long cords. The birds very seldom attempt to fly away, but are generally on most familiar terms with their owners. The average size of this pigeon is between sixteen and seventeen inches.

The foregoing is a very brief review of one of the largest and most important groups known to ornithologists. Of great value to man from the edible quality of the flesh, they supply to the native denizens of many extensive districts of the globe one of their principal means of subsistence. One curious fact regarding pigeons is, that these birds are generally absent from localities where monkeys are found; for these nimble quadrupeds, being tree-dwellers and very destructive, would rob the open, easily accessible nests of the birds of both eggs and young, and soon cause the extermination of the species. For this cause, with others, pigeons are most numerous in islands of the sea, and in countries usually destitute of predatory animals and reptiles.

D. G. ELLIOT.

ORDER XV. — ACCIPITRES.

Among birds, as among mammals, we find certain forms specially fitted for the pursuit, capture, and use as food of many other animals. Among those which are pre-eminent in the destruction of the higher forms of life are the groups of eagles and owls. These are typical birds of prey, and if we add to them the vultures, which at first thought we might be slow to do, and a single and singular long-legged and long-named bird of South Africa, — the serpent-eater or secretary bird — we shall have before us representatives of the four groups which go to make up the order Accipitres, otherwise known as Raptores or Raptatores.

Living entirely on animal substances, which they are frequently put to their wits' ends to obtain, we should expect that many features of their organization would bear directly on the manner of detecting, securing, and appropriating their food. And in fact all the members of the order are at once recognizable by a glance at the structure of the bill and feet, various though the modifications of these parts may be. The strongly hooked bill, provided with a cere, only occurs elsewhere among the parrots, and there the feet are totally different, two toes pointing forward and two backward, as in cuckoos and woodpeckers.

The cere (Latin *cera*, wax) is a membrane sheathing the base of the upper jaw, commonly soft and smooth, but frequently horny and wrinkled, in, or at the edge of which the nostrils open. The bill itself, very strongly built, is short and stout, with cutting edges and arched tip, forming an admirable instrument for tearing flesh or skin, and even breaking bones. This character is shown in all the members of the group, however much they may differ in other respects, and the adaptation to flesh-eating habits is so marked that it is hardly possible for anyone to mistake an accipitrine bird for anything else. The feet are always strong and four toed, three in front and one behind; but the owls and the fish-hawk (*Pandion*) have the outer toe versatile — turning either way indifferently. As the feet are the most active instruments in securing prey, we should expect them to vary much with the character of the food and the habits of the species, and such is in fact the case. Among those which feed mainly on dead animals or refuse of any kind, the toes are clumsy and not fitted for grasping, and the claws are usually blunt, weak, and little curved; while amongst those which attack living birds or other animals, — often larger than themselves, — the toes are very flexible as well as strong, and the claws, or talons, are very long, much curved, and extremely acute.

Doubtless the eye of a falcon or eagle is the most perfect organ of sight in existence, far surpassing that of any other animal, including man himself. Not only are they able clearly to distinguish minute objects at a distance, but in darting down from a height they must have the power to adjust the eye to distance with a rapidity and nicety simply marvellous. What must the eye of an osprey be, that he may be able, from a height of even a hundred feet, to distinguish beneath the wind-roughened water a fish so small that you might cover it with your hand, and not only see, but know whether it be only a few inches or a few feet below the surface? And what kind of sight is that which enables the barn-owl to follow and clutch in the darkness the bat which you can scarcely follow with your eye in the early twilight?

All the birds of prey are not quick flyers, but their powers of endurance are unex-

celled and perhaps only equalled among such sea-birds as the petrels. Many of them walk well, but slowly, when on the ground, while a few are able even to run; but these are exceptions, the great majority being only able to progress with much difficulty on the ground, and these always by hopping instead of walking. There is little evidence that any of them possess unusual keenness of scent, the general impression to the contrary notwithstanding. But we shall recur to this again.

In eating they often swallow much which is indigestible, such as bones, scales, hair, feathers, etc., and these substances are afterwards ejected from the mouth in large balls or rolls, technically known as castings. Their nesting habits vary much in the different groups, but the birds are always monogamous and are believed frequently to remain paired for life. The eggs are commonly few, rarely exceeding six, often only one. The period of incubation is longer than in most other aerial birds, and the young at first are covered with down, are quite helpless, and for an unusually long time entirely dependent on the parents.

In size the Accipitres vary from the tiny finch-falcon (*Microhierax*) of the East Indies, less than six inches in length and weighing only a few ounces, to the Lammergeyer and griffon-vulture of the Alps and Pyrenees, with an expanse of ten feet or more and a weight of eighteen or twenty pounds.

It may not be out of place at this point to call attention to the fact that it is among the largest birds of the order that we find the most remarkable power of flight, that is, the longest sustained and that which is apparently accomplished with the least effort. The fact that a crane, an albatross, a vulture, or an eagle can rise from the surface after a slight impetus is obtained, and then ascend in 'circles' without any perceptible motion of the wings, until actually lost to sight in the clear sky, is so well known as hardly to need mention, but the "way of an eagle in the air," the real manner in which this is accomplished, is often spoken of as an unsolved mystery. That it is not so, any person with fair opportunities of observing the phenomena, and a moderate amount of patience and common sense, may easily satisfy himself. The points he will notice, though probably not in the particular order here mentioned, will be about as follows:—

First, the bird must in some manner get a fair start, either by running a short distance, by flapping the wings, by spreading them against the breeze, or, if the ground be uneven, by gliding slightly downward from an elevation. Then it will be noticed that if there is actually no breeze at all (which will rarely happen unless in a small and closely hill-girt valley) the circling bird will be utterly unable to rise without flapping; each complete turn will bring him back to a point close to his starting-place, or at least not higher.

When the bird is able to rise without flapping, it will be found that, while gaining in height at every turn, he is also drifting off before the wind, so that the successive rings of his spiral are never vertically over each other. Should the observer ever be fortunate enough to stand on a mountain side and see an eagle rise past him in this way from the valley below to the open air above, he will not only be convinced of this, but of much more; for he will see that, throughout one half or more of each coil of the spiral, the bird not only does not rise, but actually sacrifices some elevation for the sake of gaining speed, and this is in that part of the circuit during which he is gliding *with* the wind and across it; the instant he once more turns to meet it he begins to rise, soon converting most of his momentum into elevation, or, in other words, gaining height at the expense of speed. When his headway is almost gone, he slowly turns

away from the wind, sweeps with increasing velocity around another incomplete circle, and towards its close rises another step on his airy staircase.

Sometimes, impatient apparently of the slight gain at each turn, a circle will be finished with a vigorous flap or two in the face of the wind, and then the steady circling motion be resumed again.

Of course the lower currents of air may often have a different direction or velocity from the upper ones, and this doubtless often enables the soaring bird to retrieve much of his loss due to lateral drift, or even sometimes to pass readily in what seems to be the very wind's eye. Undoubtedly, if the bird were willing and able to keep its wings inclined at the proper angle to the breeze without circling, it could rise in much the same manner as a paper kite, drifting, however, rapidly to leeward, but it would not be an economical use of either time or strength. The rapid wheeling in wide curves gives a bird complete control of its wings and enables it to preserve its balance perfectly without a thought, and so take advantage of every breath that blows. One need only reflect for a moment how much easier it is to roll a plate or wheel in a straight line on its edge than to balance it there when at rest, in order to realize the advantage gained through the continuous and rapid motion.

It is obvious also that in two birds of different weights, but with relatively the same wing-surface, the heavier bird will have the advantage over the lighter, through the greater steadiness which the greater weight insures. I do not mean to say that only the large birds of prey rise in this way. The pigeon-hawk, *Falco columbarius*, and many other small falcons, avail themselves of this power, but it is certainly seen on a grander scale, if not in higher perfection, among the eagles, vultures, and largest falcons. This is not the place to enlarge on such a subject, but it is introduced because so many of the birds of prey are experts in this kind of flight, which is less commonly understood, perhaps, than the more usual mode of progression by vigorous wing-beats.

It only remains to say that probably our utmost stretch of imagination does not enable us properly to conceive how slight is the loss resulting from friction of the air, and at the same time how great the lifting power of an almost imperceptible breeze on a bird moving rapidly against it.

In general, the food of all members of the order consists of the flesh of vertebrates, the exceptions being comparatively few, and mostly in the direction of insect-feeding. Of the forms which subsist on living prey, the great majority probably feed on other birds, to which diet is added a liberal proportion of mammals. A much smaller fraction of the whole draws the bulk of its supplies from the reptiles, while fewer members still feed largely on fish. This latter fact is rather surprising, considering the abundance and accessibility of such food.

The influence which the Accipitres exert among birds and other vertebrates is an extremely salutary one, though we lack the data for determining to what extent they aid in holding noxious forms in check, it being very certain that many of them are indiscriminate feeders, capturing beneficial as often as harmful species. It is extremely improbable, however, that they have ever been instrumental in the entire extinction of species, and in most cases it may well be questioned whether the judicious weeding out of weakly forms is not one of their most important benefactions.

In the taking and killing of prey it is interesting to note that the feet are invariably the efficient weapons, the beak being rarely used until after the victim is dead. Even the insect-eating kites and falcons clutch their minute prey with their feet, after-

wards transferring it to the bill. In a similar manner all materials for the nest and food for the young are carried in the claws; and in combat with each other, or in the repulse of intruders from their nests, the same members — aided it may be by the wings — are depended upon. Anyone who has attempted to approach a wounded eagle or hawk will remember the characteristic attitude assumed by the bird, which, throwing itself on its back, awaits the attack with wide-spread threatening talons.

In their relations to man, the Accipitres are at present serviceable in several ways, among which their destruction of vermin and their work as scavengers are the most important. Although their flesh is eaten by many tribes of savage or half-civilized men, there are strong reasons why it would never be universally popular, even if easily obtainable, and we suspect that the simile "tough as a boiled owl" is as truthful as it is trite. Many members of the Falconidæ, however, have been made eminently serviceable to man, in providing him with game at a time when sporting-arms were too primitive to yield very satisfactory results in the way of bird-flesh; while falconry as a pastime has been, in the past, one of the most universal and exciting field-sports which the world has ever known. This, however, will be noticed when we come to consider the true falcons.

As to the number of distinct species included under the head of Accipitres, there is, for various reasons, the widest divergence of opinion, but we shall probably not be far out of the way if we say that there are from four hundred to four hundred and fifty good species in all, of which about two thirds are diurnal birds and the remainder owls.

As already stated, we shall consider the order as consisting of four primary groups, which may be artificially distinguished as follows: The first family, the Gypogeranidæ, or serpent-eaters, have the head feathered, the eyes looking laterally, the nostrils separated by a bony, imperforate partition, *the legs very long*, the hind toe on a level with the rest, the outer toe not versatile, the claws blunt and but slightly curved. It embraces but a single diurnal species from South Africa.

The American vultures form the second family, the Cathartidæ. These have the head naked, the eyes looking laterally, *the nostrils not separated by an imperforate bony partition*, but communicating with each other, the legs of moderate length, *the hind toe somewhat above the rest*, the outer toe not versatile, and the claws varying with the species. Only six or eight species are known, all diurnal, and confined to America.

The third family, the Falconidæ, embraces some three hundred diurnal species of eagles, hawks, falcons, the Old World vultures, etc. These may have the head feathered or naked; they have the eyes looking laterally, the nostrils separated by a bony, imperforate partition, legs of moderate size, the hind toe on the same level with the rest, the outer toe not versatile, except in a single species (the osprey), the claws variable.

The owls, or Strigidæ, have the *eyes looking directly forward*, the nostrils as in the last family, the legs moderate, the hind toe on the same level with the rest, *the outer toe always versatile*, the claws always sharp and much curved. About one hundred and fifty species are known, nocturnal, and inhabiting all parts of the world.

In qualification of this diagnosis we may add that a few of the Falconidæ are somewhat crepuscular in habit, while at least one member of the Strigidæ is diurnal.

The singular South African secretary, *Gypogeranus serpentarius*, although unquestionably belonging among the birds of prey, is so entirely unlike the rest of them that it must of necessity stand as the type and only member of a peculiar family, the

GYPOGERANIDÆ. Some of the characteristics of this family have already been noticed, and to these we may add that the bill is shorter than the head, the upper mandible arched from the very base, and nearly half covered by the cere. The neck and wings



FIG. 124. — *Gypogeranus serpentarius*, secretary-bird.

are long, the first five primaries of about equal length, and emarginate on the inner webs. The tail is unusually long, the two middle feathers very much lengthened; the legs, and especially the tarsi, remarkably long, the hind toe only about half as long as the outer one. The skeleton also is peculiar in several respects.

The name secretary comes from the long and beautiful black or gray plumes which spring from the back of the head, and might suggest, to a person of considerable imagination, a bunch of quills stuck over a clerk's ear. The secretary is remarkable not less for the reptilivorous propensities which have given it the other name of serpent-eater than for its singular personal appearance.

Its length from bill to tip of tail is over four feet, but just about half of this is tail, while the neck is longer in proportion than in any other bird of the entire order, thus leaving but a small fraction of the whole length for the body. This is itself quite slender and mounted on strong legs longer than those of a sand-hill crane, the tarsus alone being at least thirteen inches in length. The general color of the adult is a clear, light gray, the sides of head and throat with some white streaks. The wings, lower back, thighs, and abdomen are black, while the breast and tail-coverts are white. Finally, the cere and bare skin about the eye are yellow, and the legs and feet are of a dull flesh-color.

Although a well-known bird throughout nearly the whole of South Africa, it seems to be nowhere very abundant, travelers of late years stating that it is unusual to see more than two or three pairs in the course of a day's riding in any part of the country, and they are usually so shy as to be approached only with great difficulty. Although the wings are very long and strong, it is rare to see the birds flying, and under ordinary circumstances they are seen stalking about in pairs with a most deliberate gait. If pursued, they first endeavor to escape by running, which they do easily and with surprising swiftness, only taking wing when pushed very hard.

The farmers of the Cape frequently domesticate secretaries, and they are said readily to become tame and familiar. In most of the settled parts of the country they are closely protected by law, and heavy fines are imposed for killing them. Their favorite food is said to be frogs and toads, but they seem to be always hungry, and so never very notional about their food, if it only be abundant. Le Vaillant records that the stomach of one which he examined contained eleven rather large lizards, eleven small tortoises, a great number of insects, mostly entire, and three snakes as thick as a man's arm.

In attacking a snake it would seem that they never pounce upon it from a height, in the manner of hawks and eagles, but first alight at a little distance and then stride up to the attack. These combats must be extremely interesting if we can believe the accounts of eye-witnesses.

When the snake strikes, the bird either evades the blow by skipping to one side or the other, jumping backward, or springing into the air, or else, as frequently happens, he simply receives the venomous thrust of his antagonist on the broad, stiff feathers of the outer half of the long wing, with which he knocks the reptile down, following up the fall with a vigorous kick. His extreme agility enables him in a very short time to baffle and overcome a snake of four or five feet in length, whereupon he finally seizes him near the head with his bill, and, holding the body down with one foot proceeds to swallow him. In case a snake proves unusually hard to manage on the ground, the dauntless bird watches his opportunity, seizes his adversary close to the head, and, flying aloft to a considerable height, lets him drop on the hard ground, which is usually sufficient to prepare him for the final ceremony of swallowing.

The nest, which is quite bulky, is always placed on the top of a lofty tree when one is to be found, but in scantily wooded regions a bush usually serves the same

purpose. The eggs, generally but two, are dull white, dotted with light brown at the obtuse ends.

The American vultures, constituting the family CATHARTIDÆ, are peculiar in having the hind toe inserted above the level of the rest, and the nostrils perforated, that is, opening into each other through the bill, owing to the absence of the bony partition which separates them in all other members of the order. There are many other points of interest in their structure, such as the extreme shortness of the hind toe, and the slight flexibility of the others; the comparatively short, blunt, and slightly curved claws; the decidedly long tarsus; the somewhat lengthened and obtusely pointed, slightly hooked bill; the nakedness of the head, etc. The cranial structure is also peculiar, and it was Huxley's demonstration of these osteological peculiarities which



FIG. 125. — *Cathartes atratus*, carrion-crow, black vulture.

has led to the separation of the American birds from the Old World vultures, with which, until recently, they have always been associated.

As their name implies, these birds are cleansers or scavengers, living mainly on carrion and other refuse, but frequently attacking small, weak, or sickly animals when other supplies fail.

The smallest bird of the group, at least in extent of wing, is the carrion-crow or black vulture, *Cathartes atratus*, so abundant in the Gulf states, extending as far north as North Carolina, and ranging over almost the whole of Central and South America.

It is exceedingly useful as a scavenger, and in many states is very justly protected by law, and has become as abundant and unsuspicious about the city streets as the pigeons themselves. Wilson, describing the scene about the freshly skinned carcass of a horse, says: "The ground for a hundred yards around it was black with carrion-

crows: many sat on the tops of sheds, fences, and houses within sight; sixty or eighty on the opposite side of a small river. I counted at one time two hundred and thirty-seven, and I believe there were more, besides several in the air over my head and at a distance. I remarked the vultures frequently attack each other, fighting with their claws or heels, striking like a cock with open wings, and fixing their claws into each other's heads. On observing that they did not heed me, I stole so close that my feet were within one yard of the horse's legs and again sat down."

This species is nearly black, about two feet long, and has an extent of wings of about five feet. The head and much of the neck are bare of feathers, but the plu-



FIG. 126. — *Cathartes aura*, turkey-buzzard.

mage runs up on the back of the neck to a considerable distance. The only bird which could be mistaken for the carrion-crow is the turkey-buzzard, *Cathartes aura*, but if the two birds have once been seen side by side they can hardly be confounded. The latter bird is of a more brownish color, the neck is bare all around, the tail is rounded instead of square, and the manner of flight is quite different, the present bird sailing habitually by the hour, while the former flaps the wings vigorously every few moments. The turkey-buzzard is found all over the United States except in the northeastern part, but is most abundant toward our southern border. It occurs also in the West Indies and in South America. Both this and the preceding species breed

on the ground or in a hollow log or stump, making no nest, but laying a pair of spotted eggs on the rotting wood or decayed leaves.

Among the largest birds of the Continent must be reckoned the Californian vulture, *Cathartes californianus*, which attains sometimes the size of average specimens of the condor. It is found from the Rocky Mountains to the Pacific, and in flight, food, and breeding habits, so far as known, it resembles quite closely the turkey-buzzard.



FIG. 127.—*Sarcorhamphus papa*, king-vulture.

Beyond question the bird of this group whose appearance is most striking is the king-vulture, *Sarcorhamphus papa*, a native of tropical America, most abundant in Brazil, but found as far south as Paraguay, and as far north as Mexico, and probably Arizona. Most of the plumage is pure or creamy white, rather more buffy tinted on breast and belly, while the large wing and tail feathers are deep black. The skin of head and neck is naked, or only hairy, and most brilliantly colored. Waterton gives the following description of these parts. "The throat and back of the neck are of a fine

lemon color; both sides of the neck, from the ears downwards, of a rich scarlet; behind the corrugated part there is a white spot. The crown of the head is scarlet, betwixt the lower mandible and the eye, and close by the ear there is a part which has a fine silvery-blue appearance. Just above the white spot a portion of the skin is blue and the rest scarlet; the skin which juts out behind the neck, and appears like an oblong caruncle, is blue in part and in part orange. The bill is orange and black, the caruncles on the forehead orange, and the cere orange, the orbits scarlet, and the irides white."

Unlike its near relative, the condor, it is strictly a bird of the forest, not often met with among the mountains, but preferring the wooded banks of rivers, the depths of impenetrable swamps, and the margins of broad savannas or stagnant marshes. It gets its common name of 'king' from the belief of the Indians that the other vultures stand in awe of it, and will not venture to eat until after the royal appetite is satisfied; and there appears to be considerable ground for this belief, although its size is less than that of the turkey-buzzard, and it seems to be even more sluggish.

The condor, *Sarcorhamphus gryphus*, has usually been considered the largest of the birds of prey, and the most absurd stories have been told of its strength and daring. In point of fact there are several Old World species fully as large, and some of them probably a little larger, while the Californian vulture frequently reaches the same size. Probably the condor never exceeds twelve feet in expanse of wing, and even this size can be attained but rarely, the average being probably within a few inches of nine feet. In an article by Professor Orton on "The Condors of the Equatorial Andes," we are told that "Humboldt never found one to measure over nine feet; and the largest specimen seen by Darwin was eight and a half feet from tip to tip. An old male in the Zoological Gardens of London measures eleven feet. Von Tschudi says he found one with a spread of fourteen feet ten inches, but he invalidates his testimony by the subsequent statement that the full-grown condor measures from twelve to thirteen feet."

Yet up to the time when Humboldt visited the Andes and actually measured the freshly killed birds, the wildest statements were made with regard to the size and strength of the condor, from thirty to forty feet being set down as a fair figure for the expanse of wing. Humboldt himself was at first deceived, and was astonished to find that birds which, while perched on the lofty summits of the volcanic crags, appeared truly gigantic, were in reality always less than four feet in length, and with an expanse of wing never over nine feet. Perhaps the illusion may be in part accounted for by the lack, in such situations, of all objects for comparison, but, as Darwin has thoughtfully suggested, it may be "fully as much owing to the transparency of the air confounding objects at different distances, and likewise partly to the novelty of an unusual degree of fatigue arising from a little exertion, habit being thus opposed to the evidence of the senses."

The strength of the condor has also been much exaggerated, and the stories of its carrying off sheep, and even children, in its claws are at once shown to be imaginary, not only by the failure to establish a single authentic case of the kind, but by the structure of the foot itself, which is not well adapted for grasping, the hind toe being very small and above the level of the rest, while the claws on all the toes are blunt and little curved, so that it may well be doubted, not that the condor could kill a sheep or a child, but that, having done so, it could then grasp it and carry it away. This same structure of the foot makes it difficult for the condor to perch on a tree, espe-

cially on a small limb, and so, although they do sometimes roost on trees, they much prefer to rest and sleep on bare rocks and the ledges of sheer precipices.

They are said to be such sound sleepers that they are easily caught with a noose while roosting at night. Although frequently descending to the plains at the foot of the mountains for food, their favorite haunts are among the peaks of the higher Andes, not rarely above the line of perpetual snow, and they rise easily above the



FIG. 128. — *Sarcorhamphus gryphus*, condor.

highest peaks, sweeping in graceful circles far above the snow-capped volcanoes, or gliding thence in a few seconds almost to the sea level and the torrid heat of the plains.

Although they feed mostly on carrion, they are equally fond of fresh meat, and often kill lambs, goats, and the young of cattle and deer. Probably the guanaco and vicuña furnish a goodly share of their food. They watch from an immense height the movements of the puma, and, as soon as he withdraws satisfied from his dead game, descend and speedily finish what remains.

As the condor is confined to the comparatively narrow chain of the Andes, but ranges from the Strait of Magelhaen to eight or ten degrees north of the equator, its nesting-time would be expected to vary with the latitude, and probably the eggs are laid between November and March. The spot selected for this purpose is commonly an inaccessible ledge or shelf on some precipice in the heart of the Cordilleras. Two white, unspotted eggs, three and one half to four inches long, are laid on the bare rock, and perhaps a few sticks gathered loosely about them. It is at least seven weeks before they hatch, and the young birds are not able to fly until more than a year old, and even then they hunt and roost with the parent birds for a year or two longer. Thus their development is slower than that of any other known species of bird.

When first hatched, the young condor is covered with rather scanty, whitish down, which soon deepens in color and increases in length and thickness, but is not replaced by the true feathers until the bird is nearly as large as its parents. The adult male is glossy black, with a broad white bar across each wing, and a collar or ruff of snow-white down about the neck, above which the neck is unfeathered and covered with wrinkled, dull red skin. The forehead has a fleshy or cartilaginous comb or caruncle, the throat is wattled, and there is a large, pendulous wattle on the upper part of the breast. The terminal part of the bill is ivory white, the rest dark. The adult female lacks the comb, the wattles are smaller or wanting, there is less white on the wings, and the dark colors are duller than in the male.

Before reaching this condition the young birds wear, for one or more years, a pretty uniformly brown dress, and in this stage are called by the natives of the Peruvian Andes 'condor pardo,' or brown condor. The comb of the male usually makes its appearance before the downy collar, which latter is not developed before the second year, and is not at first white.

Whatever may be the case under natural conditions, in confinement this species does not acquire its full plumage for several years, as shown by a specimen received at the London Zoological Gardens in 1877, which "was in nearly the same uniform brown plumage" six years later, and was therefore considered by Mr. Sharpe to be an undescribed species, which he named *Sarcorhamphus aequatorialis*. A specimen in the Central Park menagerie at New York, however, which at the age of six years was precisely like this 'new' species, *subsequently* acquired the full plumage of the true condor, of which therefore probably but one species should be recognized. Humboldt says that the name condor is from a word in the language of the Incas, signifying to smell, and adds: "There is nothing more astonishing than the almost inconceivable sagacity with which the condor distinguishes the odor of flesh from an immense distance." This belief in the extraordinary power of smell possessed by carrion-vultures is largely an inherited or traditional one, and was long ago shown to be without foundation. That they have some power of smell is well known, and Owen has even shown that in the turkey-buzzard the olfactory nerves are highly developed. Recognizing this fact in the anatomy of the bird, there is yet very little evidence that the power is ever used in the detection of food.

Audubon's careful experiments on the black-vulture, *Cathartes atratus*, make it certain that, in that species, sight, principally, if not solely, guides the bird to its prey. The perfectly dry, stuffed skin of a common deer, placed in the attitude of death, attracted a vulture within a few moments, though there was nothing eatable about it; after satisfying itself of which, by walking over and tugging at it, the bird circled

about over the field until it espied a small snake, not thicker than a man's finger, upon which it at once pounced. Moreover, a large and putrid carcass of a hog carefully covered by canes and brush so as to be invisible, remained undiscovered by the vultures in spite of the intolerable stench it sent out, though they frequently passed by accident quite near it, and the dogs at once discovered it. Yet a small, freshly-killed pig hidden near the same place was at once traced out by the vultures, by the blood which was allowed to run from it as it was carried to its hiding-place.

Bachman subsequently repeated some of these tests at Charleston, S. C., and added some new and perfectly convincing ones. The rough painting of a sheep, skinned and cut open, soon brought vultures to examine and tug at it, and though the experiment was repeated scores of times it never failed, on each fresh exposure, to attract the hungry birds. A wheelbarrow-load of tempting carrion was next covered by a single sheet of thin canvas, above which bits of fresh meat was strewn. The fresh meat was soon eaten, but although the vultures must frequently have had their bills within an eighth of an inch of the carrion beneath, they did not discover it.

While at Valparaiso in 1834, Darwin experimented on twenty or thirty condors which were kept in a garden at that place. They were tied in a long row at the foot of a wall, each bird by a single rope, and Darwin walked backward and forward before them, at a distance of about ten feet, with a piece of fresh meat in his hand, wrapped securely in a piece of white paper. No notice whatever was taken of it by the birds. He then threw it on the ground within a yard of an old male condor, who looked at it carefully for a moment and paid no further attention. With a stick it was pushed closer and closer, until he touched it at last with his beak, when instantly the paper was torn off, while every bird in the long row began struggling and flapping its wings.

The evidence on the other side of the question is very meagre. Darwin tells us that a "gentleman mentioned at a meeting of the London Zoological Society that he had twice seen the carrion-hawks in the West Indies collect on the roof of a house when a corpse had become offensive from not having been buried;" and a case is cited by Mr. Gosse in his "*Birds of Jamaica*," where the stench from the putrid contents of a soup-pot in a house caused one vulture after another, as he passed over, to descend toward the house and sometimes take several turns about it before reluctantly resuming his course. There is nothing however, in either of these cases that would justify us in ascribing any *unusual* power of smell to the vultures even if we admit that their actions were consequent on the odors they perceived, for the same odors were perfectly perceptible to men in the neighborhood at fully as great a distance as that at which the vultures are supposed to have discovered them.

On the whole, when we remember the disgusting character of much of the vulture's food, as well as the similar odor which of necessity the bird usually bears about with it, we can hardly see how it would be possible for it to detect at a distance the odor even of carrion,—much less that of perfectly fresh meat or of living animals. The obvious and simple explanation of ninety-nine one-hundredths of these remarkable discoveries was first pointed out by Audubon and has been almost universally accepted since.

Probably in most regions where vultures of any species are fairly abundant, every nook and corner of the surface is carefully scrutinized many times a day, and by many pairs of hungry eyes. Wheeling in graceful curves at varying heights, some scarcely higher than the house-tops, others only visible to the human eye as mere moving

specks in the blue sky — each bird is keeping silent watch not only of all that transpires below him, but of every movement of his more or less distant companions. Thus it is sufficient if but one bird discover anything eatable; his change of movement at once signals his discovery to his nearest companion, who hastens to share the feast. His eagerness betrays his secret to other watchful eyes, and so by an almost faultless, yet unintended, system, the news is noiselessly spread for miles almost before the original discoverer has reached his prize. If the find be small, such, for example, as a dead rat or small snake, the lucky finder disposes of it without assistance and soon resumes his regular and well-understood motions, thus checking the arriving guests almost as soon as they have received their invitations.

If, on the other hand, the supply of food in prospect is large, the invitation may be spread indefinitely, and if the meat be fresh, and covered by a hide too tough to be at once torn, there is nothing to do but to wait until decomposition shall have softened it, or some carnivorous quadruped shall make an opening, thus giving time for some of the birds to come from great distances, often, perhaps, a hundred miles or more.

The great bulk of the diurnal birds of prey are included in the family *FALCONIDÆ*, to which we now turn our attention. Here we find the largest as well as the smallest of the *Accipitres*, and the one similar plan on which all are constructed is expressed in so many different ways, and with such endless variations of detail, that at first one is sorely puzzled to know which should be considered the higher and which the lower forms. It would be impossible, however, to arrange the species in any linear series which should show with even tolerable accuracy their true relations, and we shall hence simply assume that the vultures are the lowest, and the falcons the highest, and arrange the intervening groups as best we may, merely remarking that while we here recognize eight sub-families, as being more in conformity with general usage, half as many would, perhaps, answer equally well, and there is much to be said in favor of Mr. Ridgway's proposition to make but two, namely, the *Buteoninæ* and *Falconinæ*. The purely osteological characters, however, on which these are founded are hardly so suitable for the present purpose as the more superficial ones by which the more numerous divisions which we here adopt are usually defined.

These sub-families are: The *Vulturinæ*, or Old World vultures; the *Aquilinæ*, including the eagles and buzzards; *Pandioninæ*, with its single species, the osprey; *Circinæ*, the harriers; *Milvinæ*, the kites; *Polyborinæ*, the carrion-buzzards; *Accipitrinæ*, the true hawks; and *Falconinæ*, the falcons.

Collectively, the *Falconidæ* may be defined as those diurnal *Raptores* with imperforate nostrils, in which the legs are either short or of only moderate length, the tarsus never exceeding six inches. If, for the moment, we leave out of consideration the *Vulturinæ*, whose structure will be noticed shortly, we may add that the head is always largely feathered, the bill strongly hooked, and the claws curved and sharp. The minor modifications, as well as the habits, of the birds comprised in this populous family will be most conveniently noted under the sub-families to which they belong.

The *Vulturinæ*, or Old World vultures, form a group of carrion-feeding *Raptores*, which may be recognized by the following characters: Head and neck more or less destitute of feathers, either bare or else bristly or downy, no true feathers on the top of the head. Feet robust and strong, but not very flexible; hind toe inserted at the same level as the rest. Size large, length from bill to tip of tail two to four feet. Young fed at first by regurgitation, later probably by food carried to them in the claws by the old birds.

There is now no doubt that the so-called true vultures, *i. e.*, Old World vultures, are simply modified buzzards or eagles, adapted for an almost exclusive diet of carrion. Much as they have been modified, they still retain all the essential characters of the Falconidae. The partial nakedness of the head and neck, together with the weakness of the feet and bluntness of the claws, are the principal external differences from the other members of the family, while the internal anatomy is very similar in both. Like the other Falconidae, they commonly construct bulky nests, or use such nests already constructed by other birds, and this fact, together with the bringing of food to their young, shows a palpable difference in the prehensile power of the foot between these and the American vultures; for few birds are able to fly with any considerable weight in the bill, and the Accipitres habitually use the feet for this purpose when it becomes necessary to transport food or building-materials.

In the countries bordering the Mediterranean no less than six species of vulture are of regular if not common occurrence, and four of these occur in southern Europe; the remaining two, *Gyps rüppelli* and *Gyps africanus*, are African species, only reaching the Mediterranean at the northern limit of their range. Three of the four which occur in Europe are among the largest of living birds of prey, having a length of almost four feet, and an extent of wings of nine or ten feet. They are the crested black-vulture, *Vultur monachus* (otherwise known as the Arabian or cinereous-vulture), the griffin or fulvous-vulture, *Gyps fulvus*, and the Nubian or eared-vulture, *Otogyps auricularis*, sometimes improperly called the sociable vulture. The other species, the Egyptian vulture, *Neophron percnopterus*, is much smaller, measuring only twenty-five inches in length, thus corresponding in size quite closely with the black-vulture, *Cathartes atratus*, of America.

The crested black-vulture, the type and only species of the genus *Vultur*, is found throughout southern Europe and northern Africa, extending eastward through Asia to China. Its plumage, when adult, is dull, sooty black, with brownish reflections in certain lights, and only relieved by the livid flesh color of the bare skin about the neck, the base of the bill, and the feet. The head and throat are completely covered with short, soft, downy, black feathers, which run down to a point on the throat. The neck, which with this exception is bare, is encircled by a ruff of pointed, downy feathers, longest at the back. Immature birds are much browner. The nostrils are very small and almost circular, thus differing from those of all other members of the sub-family. In Europe it seems to be most abundant along the southern Danube and in Spain. Its nest, which is of immense size, is almost invariably placed on a tree, sometimes high up, sometimes not far from the ground, but commonly on the steeper slopes of mountains, or near their summits. The single egg usually laid in each nest is from three and a quarter to four inches in length, and about two and a half to two and two-thirds inches in breadth, and richly spotted and blotched with red. Several nests are frequently found within a few hundred yards of each other. This species is ordinarily slow and heavy in its action, but spends many hours each day sailing at great heights watching for food. In Sardinia, where it is quite common but, as elsewhere, rather shy and suspicious, Mr. A. B. Brooke found its nest, containing a single young one, on the first of June. The nest "was built high up in the mountains, on the very top of an old stunted ilex, forming a large shallow platform about five feet long by four broad." Of this bird's voracity the same observer gives the following instance: "On one occasion I had placed the skinned carcass of a moderate-sized sheep in an open vineyard surrounded by thick cover, in hope of attracting some birds of prey.

I had sat by it for several hours without anything having perceived it, and, getting tired of waiting, moved away two hundred or three hundred yards. I had scarcely done so when a common kite (*Milvus iclinus*), flying by, caught sight of the meat, and after soaring round once or twice, lit; he was hardly down when a cinereous vulture appeared at a great height, rapidly descending in circles, which became smaller and smaller as he reached the ground; he was followed in quick succession by two ravens, another kite, another cinereous vulture, and an eagle (*Aquila bonelli*, I think), which latter, however, did not light, but kept soaring round and round.

"In the mean time I stalked to the spot as quickly as possible, and managed to kill a vulture, and then to my surprise, on looking at the sheep, found literally nothing left but the clean-picked ribs, backbone, and head. I feel quite sure that I am over the mark when I say six or seven minutes was the outside limit of the time the vultures were on the ground, and one bird not more than half that time. The one I shot was a fine old female, weighing sixteen and a quarter pounds; the weight of a male I afterwards shot was only fifteen pounds.

"The length of the female in the flesh was forty-one inches; from carpal joint to end of wing thirty inches. Vultures do not appear to begin to hunt very early in the morning, but wait until the sun is well up; and few are to be seen during the extreme heat of the day, which seems to show that they rest at that time. Their power of going without food must be very great, as it is improbable that a comparatively small island like Sardinia supplies enough dead carcasses to give each bird a meal every day. These birds hunt over an enormous extent of country; the pace with which they soar through the air, when going from one point to another, can only be realized from the inconceivable rapidity with which they pass out of sight on a clear day when flying at great heights." There seems to be no evidence that this species commonly attacks living animals of any kind.

The griffon-vulture, *Gyps fulvus*, may be taken as the type of a genus containing three or four good species and as many more doubtful ones, or perhaps more correctly geographical races which are candidates for specific distinction. The griffon is in size and habits very nearly like the preceding species, but differs much from it in color, the large wing and tail feathers alone being black, all other parts quite light-colored, or mottled with light and dark. The nest also is usually placed on cliffs or among rocks, and contains a single large white egg, without spots. *Gyps rüppelli*, *indicus*, and *bengalensis* are similar birds, the first from Africa and the two others from India and the Malay peninsula.

Mr. R. C. Beavan, writing of the vultures of India, says the Bengal vulture "breeds in Maunbhoom in February, choosing for the purpose almost invariably a large semul or cotton tree, which at that time of the year loses its leaves and puts forth its fine scarlet flowers; hence the nest, which is generally placed at the junction of two large limbs, or at the diverging point of several branches from the trunk, is plainly visible, but not easy to get at; for the vulture chooses the largest trees it can find, and most of them are smooth, large in girth, and devoid of branches near the ground. The nest is circular, compactly built of fresh twigs with the leaves on. Eggs two, dirty white, frequently blotched with red, which, however, is either blood or dirt, for it is removable by brushing with soap and water. On my way down to the plains from Simla in October, 1866, I came across several of this species, which I have found abundantly distributed in every part of the plains of India hitherto visited by me. On the occasion alluded to, numbers of cattle had been used for the

purpose of carrying down baggage from Simla to the plains, and, as a matter of course, several had died on the way.

"One which I found on the roadside was surrounded by crowds of these vultures. On going up to examine it, I disturbed about forty of them, most of which flew up into the neighboring trees. On going near the carcass, I was surprised to hear a rumbling noise proceeding from its inside. There was a good-sized hole dug out by the bills of these birds in the neck of the carcass, and also another near its anus, while the



FIG. 129. — *Gyps rüppelli*, Rüppell's vulture.

stomach was swollen out and distended as if with air. On hitting this with my stick it appeared to be filled out by something inside, and in a few minutes, to my great astonishment, I found that there were more vultures, all alive, inside the carcass! Two following each other in quick succession shortly afterwards walked out through the hole in the neck of the bullock, and the first immediately flew off to a neighboring tree, whilst the other was so gorged he could not do more than waddle off to a rock close by, on which he sat, whilst I left him and concluded my journey."

The genus *Otogyps* is distinguished by its bare head, with fleshy folds arising beneath the ears and falling down the sides of the neck, forming the so-called ear-lappets. The Nubian vulture, *Otogyps auricularis*, is found only in Africa, and the most typical specimens only in the southern part. The Pondicherry vulture, *O. calvus*, occurs in India, and thence eastward to Siam. It is much smaller and darker than the preceding, has a small ruff of black feathers about the neck, and the inner face of



FIG. 130. — *Otogyps calvus*, Pondicherry vulture.

the thigh is bare. It is rather a solitary bird, rarely more than two or three being seen together, nests usually in trees, and lays white eggs.

The genus *Neophron* probably comprises but two species, *percnopterus* and *pileatus*, the latter confined to Africa, the former having a much wider distribution. In India, a smaller race of *percnopterus* is found, sometimes considered a distinct species under the name *ginginianus*, while in tropical Africa a similar race of the more southern *pileatus* exists.

The typical Egyptian vulture, *N. percnopterus*, is sometimes found in northern Europe, and has once or twice occurred in England. It is abundant in all the coun-

tries surrounding the Mediterranean and Red seas, as well as throughout Africa and in northwestern India. Owing to its very light color it is frequently called the white-vulture; in Africa the Dutch colonists call it the white-crow, and, as it frequently figures in the hieroglyphs of Egypt, it is also known as 'Pharaoh's chicken.' Wherever it is abundant its usefulness as a scavenger is recognized, and it is carefully protected by law as well as frequently by superstition, so that in nearly all the cities and towns of southeastern Europe, and in fact wherever it is found in tolerable abundance, it is one of the most familiar objects in the streets, and a group of them may often be seen wrangling for some scrap of offal among the very feet of the horses and camels of a market-place. With the giffons and several other species, it is a never-failing attendant on the deserted battle-field, and, with the help of the jackal and hyena, desecrates many a lonely cemetery. According to Mr. F. G. C. Taylor, in and about Constantinople it is very abundant, sitting on the roofs of the houses, and breeding on the ruined walls and towers of Stamboul. The eggs, three or four in number, and unlike those of other Old World vultures (except *V. monachus*), are strongly blotched with brown and red, the markings often completely obscuring the ground color. The young birds are of a blackish brown color, after the first year becoming more yellowish, but not assuming the final plumage of the adult—mostly white, with the large feathers of the wing black—until the third year. It is stated that the bill of the male, which is ordinarily yellow, deepens in color to a clear orange during the breeding season.

The transition from the vultures to the eagles and buzzards is a natural and not very abrupt one, when we consider that at least two of the genera which we now take up have been sometimes included in one group and sometimes in the other, according to the fancy or conviction of the author handling the subject.

Under the head of *Aquilinae*, we propose to consider those forms which are commonly placed in two separate groups, the *Aquilinae* or eagles, and the *Buteoninae* or buzzards. Our reason for this is simply that the two groups are not fairly separable; that while marked differences aside from size undoubtedly exist between a golden-eagle (*Aquila*), and a 'hen-hawk' (*Buteo*), and even between small groups of which these two are typical members, yet in the presence of the vast number of forms which are admitted to be very closely related, but which cannot come into either group so long as the groups themselves are separated, we cannot do less than merge the two in one and include all the most nearly related forms. The trouble is, however, that having done this, having opened our doors to these homeless robbers, we are in a fair way to be looked upon as an asylum for discontents, or rather for those semi-orphans whose parentage we may indeed know, but whose ancestry is as yet involved in obscurity. Thus the harriers will be wanting to come in next, then some of the kites, and perhaps all of the hawks. Under these circumstances, the only thing to do would be to give each applicant a rigid examination and admit him if possible. But at least let us quarantine the carrion-buzzards (*Polyborinae*) as long as possible, and especially let us be careful not to add insult to injury in the case of the osprey by forcing him into any closer relations with a group the very name of which must always call up painful recollections.

But to return to facts: the *Aquiline* group which we have introduced may be in general negatively characterized as follows. Bill not toothed as in the falcons, the cutting edge of upper mandible even or sinuate; face without the imperfect disk of the harriers; the bony shield over the eye usually prominent; legs and feet heavier

and shorter than those of the hawks; tarsus evidently shorter than the tibia, usually scutellate in front and behind, or else feathered; claws always long, much curved and sharp; wings various, but usually rather short, broad, and rounded. In the progress from youth to maturity the changes in plumage are generally several, and frequently the successive stages are very unlike each other. In other cases, although the young plumage is very unlike that of the adult, the latter is assumed very gradually and almost imperceptibly. In very many cases marked changes of general color resulting from the change in color of the feathers themselves without the loss of any old, or the gain of any new ones. The time required to obtain the adult dress is also very different in different species, and probably varies considerably in individuals of the same species. In not a few the young birds molt at once into the mature dress, in others this is not obtained for at least five or six years, and there seems to be no doubt that occasionally there are individuals which never assume it, though they may live to old age.

Moreover the various stages peculiar to any given species are not necessarily passed through by every individual, and even if they are, all do not assume them in the same order. Finally, melanism is of frequent occurrence, not only black individuals occasionally appearing in almost every species, but black races are not infrequent, in which case the melanism may be (?) only temporary, or, as seems more often to be the case, the abnormal coloration is permanent. Much of what has been said here with regard to variation of plumage is applicable equally to other sub-families, but as it is particularly noticeable among the buzzards and eagles I have dwelt on it here.

In the light of all these facts it will readily be seen how difficult is the discrimination of species, and how perplexing the literature of the subject through the description as valid species of all the different forms which a single one may show. As an extreme illustration of the ease with which species are manufactured we may mention that in 1875 a European ornithologist of some prominence described as "new" a species, the only example of which was then living in the Zoological Gardens at Antwerp. This, according to his own description, was extremely similar to a well-known and variable species, and moreover he had actually never seen the bird he described as new. We can therefore hardly be surprised when he mentions as one of the characteristics of his new species that it is "silent in confinement."

Too much reliance has often been placed on the change or permanency of plumage in captive birds; and while such specimens are frequently invaluable, and we are indebted to them for much of our true knowledge of change in plumage, yet we should never lose sight of the fact that birds living under abnormal conditions are very liable to become abnormal themselves.

The age which birds of prey attain is very uncertain, and the data on this point very meagre. The general statement has always been that "eagles probably live to be at least one hundred years old." Many cases, indeed, are on record where eagles are *believed* to have lived more than one hundred years, but we know of no instance where this was absolutely known to be true. At least one authentic instance has been recorded, however, of a white-tailed eagle, *Haliaetus albicilla*, which lived in confinement until upwards of eighty years old.

The eagle-vulture, *Gypohierax angolensis*, of West Africa, combines, as its name suggests, some characters of both the eagles and vultures. Its size and general bearing would place it with the former, but its carrion-eating habits, coupled with the bare skin of the sides of the head, suggest the vultures. It is a beautiful bird in its appearance, especially when seen seated solitary, as its custom is, on the bare top of some

commanding tree, giving a wide outlook over river and forest. Its plumage is mainly snowy white, the wings and tail alone being mostly black, the latter with a broad terminal white band. The legs and feet are pink, and the bare skin about the head flesh-colored. Though it ordinarily lives on carrion it has been known to stoop at living prey, Mr. H. T. Ussher having shot one in the act of striking a kid tethered in the woods as a bait for a leopard.

The bearded-vulture or Lämmergeyer, *Gypaëtus barbatus*, is one of the most noted of all the birds of prey, holding much the same place with regard to the Pyrenees, Alps, and Himmalehs that the condor holds in the Andes.

A bird of magnificent proportions and savage aspect, it is nevertheless much less harmful than many of the smaller eagles, though tradition accuses it of the most daring attacks on chamois, mountain goats, and even mountaineers themselves. The mode of attack commonly ascribed to it as follows: Watching stealthily for an unguarded moment, when its victim is near the edge of a precipice, it sweeps down with tremendous velocity, and, by the force of its rush, followed up perhaps by blows of the wings, forces its half-stunned and bewildered quarry over the brink, afterwards descending itself to feast at leisure on the lifeless body.

Dresser, in his "Birds of Europe," says of this habit: "Many of these accounts are greatly exaggerated. It partakes far more of the vulture in its habits than of the eagle, feeds on carrion and such refuse as it can pick up, sometimes doubtless attacking weakly lambs or catching mountain hares. There are, however, authentic records of its having attacked children when impelled by hunger."

Mr. Salvin, who found several pairs breeding in the Atlas range in northern Africa, says that their food there consisted principally of land-tortoises, *Testudo mauritanica*, which they carried to some height in the air, letting them fall on a stone to break the shell.

Another observer, writing of its habits in Greece, says: "The Lämmergeyer may be observed floating slowly at a uniform level close to the cliffs of some deep ravine, where his shadow is perhaps projected on the wall-like rocks. If the ravine has salient and re-entering angles, he does not cut across from point to point, but preserves the same distance from the cliff, and when he disappears at any lateral fissure, you feel sure of the very spot where he will emerge on turning the corner of the precipice. Marrow-bones are the dainties he loves the best, and when the other vultures have picked the flesh off any animal he comes in at the end of the feast and swallows the bones, or breaks them and swallows the pieces if he cannot get the marrow out otherwise. The bones he cracks by taking them to a great height and letting them fall upon a stone. This is probably the bird that dropped a tortoise on the bald head of poor old Æschylus."

In color the adult male Lämmergeyer shows strong contrasts, most of the under parts and the neck being rich, light rusty yellow; the wings, back, and tail blackish brown with white shaft-streaks; the forehead and crown creamy white, the sides of the head and a bunch of long black bristles on the chin jet black. The iris is pale orange, but the sclerotic membrane is blood red, giving the bird an almost diabolical look when excited. Full grown individuals range from three to four feet in length, and have an extent of wings of nine or ten feet.

The bulky nest is usually placed in some inaccessible cleft or cavern in the face of a cliff, and the single egg (rarely one more) is dull yellow, clouded or washed with rusty. The birds are much sought after on account of their feathers, and their nests

are likewise robbed whenever they are found in accessible places: the eggs, from their rarity in collections, always bringing a good price. Hence the Lämmergeyer is fast disappearing from Europe, being now very rarely seen in Switzerland, where it was once common, though still found in some numbers in Spain, where it has been less persecuted.

A second species of *Gypaëtus*, *G. meridionalis*, is credited to northeastern Africa, and is said to be easily distinguished by having the lower part of the tarsus bare. It also differs somewhat in head markings, but all the differences are so slight, and the characters themselves so variable in the true Lämmergeyer, that probably it will prove to be merely a geographical race of this bird.

We give the following anecdote of this species on the authority of Rev. J. G. Wood, who says: "Bruce gives a graphic and amusing narrative of the cool audacity that was displayed by one of these birds. The author, with a number of his attendants, were seated on the summit of a mountain, engaged in cooking their dinner, when a Lämmergeyer came slowly sailing over the ground, and boldly alighted close to the dish of boiled meat around which the men were sitting. Undismayed by their shouts of distress, he quietly proceeded to reconnoitre the spot, while the men were running for their spears and shields, and, going up to the pot in which some goat's flesh was boiling, he inserted his foot for the purpose of abstracting the meat. Not being prepared for the sudden scalding which ensued, he hastily withdrew his foot and fastened on a leg and shoulder of goat's flesh which were lying on the dish, carrying them away before he could be intercepted. The attendants were quite afraid of the bird, and assured Mr. Bruce that it would return in a short time for more meat. Accordingly, in a very few minutes, back came the Lämmergeyer, but was evidently rather suspicious at the look of Mr. Bruce, who had taken up his rifle and was sitting close to the pan of meat. In spite of the shouts of the attendants, the bird, which evidently held in the greatest contempt the warlike capabilities of the natives, and was not prepared for European weapons and hands, settled on the ground about ten yards from the meat, and the next instant was lying dead on the earth with a rifle-ball through its body. When brought to the scales the dead bird was found to weigh twenty-two pounds, and the expanse of its wings was eight feet four inches, although it was undergoing its moult at the time."

Most of the typical eagles are included under the genera *Aquila* and *Haliaëtus*, each of which comprises from five to twenty species distributed through all countries, but perhaps most poorly represented in North America, where we have only one species of each genus, viz., the golden-eagle, *Aquila chrysaëtus*, common to Europe, Asia, and North America, and the bald-headed eagle, *Haliaëtus leuccephalus*, peculiar to North America. The Old World white-tailed sea-eagle, *H. albicilla*, which very closely resembles a large and poorly colored bald-eagle, is found in Greenland, but not elsewhere in North America, though abundant in Europe and Asia and even in Kamtschatka and the Aleutian Islands.

In *Aquila* the tarsus is feathered to the toes; in *Haliaëtus* only about half way from heel to toes. The members of the genus *Aquila* are often spoken of as 'true eagles' as distinguished from the equally large but less regal *Haliaëti*, which are certainly more addicted to fishing, and perhaps oftener feed on carrion, but in this latter particular there is little choice. Other writers call both these genera 'true' eagles, relegating to the 'so-called eagles' the related genera *Haliastur*, *Helotarsus*, *Nisaëtus*, and almost any hawk or buzzard of large size.

We may take as our type of the eagles the golden-eagle just referred to, one of the largest of its genus, and unfortunately far from common in America. It ranges from Mexico northward, being most abundant in mountainous regions, where it usually nests on inaccessible cliffs, and lays two or three eggs, which are commonly brown-spotted, though occasionally white like those of the bald-eagle.

On the other side of the Atlantic it ranges somewhat further south, being abundant in the Atlas mountains of northern Africa, and of common occurrence in India,



FIG. 131. — *Aquila mogilnik*, Imperial eagle.

and, though everywhere a mountain-loving bird, in the two last-named places, it not unfrequently nests in trees. In Great Britain at one time both this and the sea-eagle were verging on extinction, owing to the bounties paid for their destruction on account of their depredations on flocks. It is now, however, not uncommon in Scotland, and in some localities there even seems to be increasing in numbers, probably owing to two causes combined, one the protection granted it by the owners of many large estates, and the other that extended to it by the shepherds and mountaineers

themselves, who have learned that a large price can be obtained for its eggs, and so, after robbing a nest once each season, allow a second set of eggs to be hatched and the young to be reared. The American bird has usually been considered a variety of the Old World species, and distinguished by the name *canadensis*. The only points, however, in which the two forms differ, are the slightly larger size and darker plumage of the American bird, the latter point being most easily recognized in the young. The adults range in length from two and one half to three feet, and the wings spread from six to seven feet.



FIG. 132. — *Haliaeetus vocifer*, African sea-eagle.

The smallest member of the genus is the dwarf-eagle, *Aquila pennata*, a native of southern Europe, north Africa, and India, which measures only eighteen inches or two feet in length. Other notable species are the king-eagle, *A. heliaca*, of southeastern Europe and Asia, equalling the golden in size, and supposed by many to be the species once adopted as the emblem of the Roman empire; the imperial eagle, *A. mogilnik*, but slightly inferior to the last, and with about the same range; *A. verreauxi*, of south Africa, and *A. (Uroaetus) aulax*, the bold or wedge-tailed

eagle of Australia. This latter differs from all the other members of the genus in having the long tail strongly graduated, the outer feathers being five or six inches shorter than the middle ones.

Severtzoff, in his "Fauna of Turkestan," says of the king-eagle, *A. heliaca*, "During summer it is found in all parts of Turkestan, but breeds only in the salt plains near Jorteck. During the breeding-season it is only found near its breeding-haunts, but frequently wanders and changes its residence during the winter. Like other eagles, it breeds only every alternate year. So soon as the young are full-grown they commence to change; but the plumage changes very slowly. During the winter the moult is arrested, and recommences in the spring of the following year; and they never breed whilst this moult is progressing."

Among the sea-eagles, the North American bald-eagle, *Haliaeetus leucocephalus*, is a familiar example, and too well known to need description. Of about the same size as the golden-eagle, it differs much from it in habits, haunting the shores of lakes and rivers, but especially the sea-shore, living mainly on fish, which it sometimes catches for itself, sometimes robs the osprey of, and probably most often finds cast up dead on the shore. The nest is most frequently placed on a high tree, but in sections where suitable trees are not to be found, it places its nest on rocky cliffs or precipitous banks. The eggs, which are laid very early in the season, are never (normally) less than two, which is the regular number, though sometimes three or four are laid. They are nearly spherical, dull white, unspotted, and average about three inches by two and three-quarters.

The finest bird of the genus is undoubtedly the northern sea-eagle, *Haliaeetus pelagicus*, of northeastern Asia. It is readily recognized by its large size, with extremely large bill, euneate or graduated tail (of fourteen feathers), and white thighs, shoulders, rump, and tail, the other parts being brown. The African sea-eagle, *H. vocifer*, is remarkable for a coloring unusual in this group. The head, neck, breast, and tail are pure white, the remainder of the under parts, including the thighs, sides of body, and under wing-coverts, deep chestnut; while the upper parts are brown or black. It is a comparatively small bird, being little more than half the size of the bald-eagle, and closely approaching in size the common red-tailed hawk, *Buteo borealis*. This is the smallest eagle of the genus unless we except the nearly related *H. vociferoides* of Madagascar, which is of the same size and with somewhat similar colors. Like the other members of the genus, these birds feed largely on fish, and are seldom found at any great distance from water.

Closely allied to *Haliaeetus*, if indeed it is not really congeneric, is the peculiar fishing-eagle, *Poleiobuteus ichthyophagus*, of India and the East Indies generally, an eagle with almost the exact habits of the osprey (*Pandion*), subsisting entirely on fish, and with its external anatomy much modified to suit its requirements, its talons being much curved, very sharp, and rounded almost precisely as in that species. Two species are known.

Here may be mentioned a small group of two or three species very closely allied on the one hand to *Aquila*, from which, however, they are distinguished by their longer legs, and on the other to the hawk-eagles, *Spizaetus* and allies. The most familiar member of the group in Europe is Bonelli's eagle, *Nisaetus fusciatus*, a common bird of the Mediterranean region, and extending eastward to India.

Under the name of hawk-eagles are grouped a dozen or more raptors of medium or large size, and often of striking plumage, belonging to several genera, mainly

Spizaëtus (or *Linnaëtus*) and its subdivisions, *Lophoaëtus*, *Spiziastur*, etc. Several of the species are beautifully crested, as, for example, *Lophoaëtus occipitalis*, of South Africa, one of the smaller species, but with a black occipital crest over four inches long. This is rather a sluggish bird, feeding much on rats, but frequently helping himself to poultry also. The crowned-eagle, *Spizaëtus coronatus*, which has nearly the same range as the last, is a much larger bird, with the under parts richly banded with black on a buff ground, and an ample occipital crest of long, blackish



FIG. 133. — *Circaëtus gallicus*, serpent-eagle.

brown feathers. Several species are also found in Central and South America, among which are the crested *Spizaëtus* (*Lophotriorchis*) *isidori*, and *S. ornatus*.

Probably the Malayan black-eagle, *Neopus malayensis*, belongs with this group, though its remarkably small outer toe and claw—almost aborted it would seem—might be taken as an indication of other affinity. This species is crestless.

An interesting bird, related to those just mentioned, is the short-toed or serpent-eagle, *Circaëtus gallicus*, which inhabits the countries about the Mediterranean, and

extends northward into central Europe, and eastward into India. It is plainly but prettily marked, the under parts being mostly white, profusely spotted with brown, while the upper parts are pretty uniform dark brown. It feeds almost exclusively on reptiles, particularly frogs, lizards, and snakes. Canon Tristram, in writing of this bird, says: "They will often dash down to the field below, sweep for a few minutes like a harrier, and then, seizing one of the great black ground snakes or a *Tropidonotus* in



FIG. 131. — *Morphnus guianensis*, Gulana eagle.

a ditch, sit down and occupy some minutes in killing the reptile, after which they carry their prize away in their claws, not, like many other eagles, devouring it on the spot."

There are several other species of this genus, all crestless or only slightly crested, while as many more with conspicuous crests have been separated under the generic name of *Spilornis*. Members of both genera might properly be called short-toed eagles, and all seem to have rather similar reptile-feeding habits, with a preference for snakes.

Amongst the scores of other species belonging to this populous sub-family, it is only possible for us to notice a few of the most striking or typical. The species thus far spoken of seem rather closely related to the eagles, and perhaps more especially to *Aquila*. There are many others, however, which would naturally be associated with the buzzards, although from their size many of them are called eagles, and at once suggest the *Haliaëtus* type; while, finally, not a few are referred by naturalists almost as often to one group as the other. An example of this latter class is seen in the short-tailed eagle, *Helotarsus caudatus*, from the lower half of Africa, remarkable for its rich maroon and black plumage, crested head, extremely short tail, and coral-red legs and feet.

Tropical and South America furnish us with a group of three remarkably large, crested species, usually referred to as many genera, which may collectively be fairly called buzzard-eagles. The smallest is the Guiana eagle, *Morphnus guianensis*, in which, however, the tail is longer, both proportionally and actually, than in either of the others, if not indeed than in any other eagle whatever, the Australian wedge-tailed eagle possibly excepted. The wings, on the contrary, are, as in the two following genera, rather short and rounded, these birds being better fitted for pouncing suddenly and at short range on their prey, than for lofty sailing and long stoops, while the lengthened but very strong tail must be of great use in the close and tortuous pursuit of birds among the dense forests which these birds love to make their homes. This eagle inhabits the dense forests of the Amazon as well as those of Guiana, but is almost exclusively a forest inhabiter, rarely, if ever, ranging over the open country.

Harpyhaliaëtus coronatus is another crested form, but little inferior in size to the bald-eagle, of a pretty uniform ashy brown color, with white-tipped upper tail-coverts, and two white bars on the tail, a narrow one at tip, and a broad one in the middle. Though a powerfully built bird, and on occasion a daring hunter, it frequently, like so many of its 'nobler' relatives, contents itself with carrion. Described by Azara as long ago as 1802, it is still a rare bird in collections, though fairly abundant in some parts of southern South America.

The harpy-eagle, *Thrasaëtus harpyia* (also known as *Harpyia destructor*), is one of the most powerful birds of prey in the world. In total length it is slightly greater than the golden-eagle, owing to the great length of tail. In expanse of wings, however, it is rather less; but when we come to compare the proportions of beak and claws, and the strength of the bony framework, it is evident that the harpy is without a rival. Dr. Oswald, in the "American Naturalist" for March, 1878, thus describes its physique:—

"A square, strong head, armed with a most viciously curved, powerful bill, that can crush a man's finger-bones without any special effort, and dislocate the neck of a squirrel-monkey by a single wrench. Broad, compact wings, moved by shoulder muscles of enormous strength, and a pair of stout legs feathered to below the tarsi, that terminate in claws of such extraordinary power and sharpness that they leave marks on the skin of a quadruped, and even on the tough leather of a Mexican saddle, like the bite of a wild-cat. The harpy is often killed for the sake of its feathers—I mean for the feather-bed value of its plumage—by the Mexican Indians, and, if plucked, yields about four pounds of soft, grayish-white down, beside the stiff wing and tail feathers and the bristling tuft which crowns its head. This plumage is so elastic, so compact, and so firmly imbricated, that buckshot, striking the wings or the breast of the bird at a certain angle, glance off or fail to penetrate to vital parts:

and monkeys or foxes which in their death-struggle snap at what they mistake for the throat of their captor, shut their fangs upon a mass of elastic down, which baffles their efforts till the grip of the *destructor* closes upon their own throats.

"The harpy can overtake the swiftest birds of the tropical woods, and in spite of its size steers its way through the labyrinth of forest trees and hanging vines with



FIG. 135. — *Thrasaetus harpyia*, harpy-eagle.

amazing skill, and rarely fails to rise with a pheasant, a woodcock, or a small mammal in its claws, after plunging like a meteor from the clouds into the leafy maze of the *tierra caliente*."

When adult, its general color above is gray, while the head and neck all round, as well as the entire underparts, are white, excepting the long crest feathers, and an indistinct chest-band, which inclines to gray. The tail-feathers are brown, crossed

with six imperfect bands of black, with which color the interspaces also are plentifully mottled. The immature bird is very different — one of the characteristic phases being almost white below, with a broad band of glossy black feathers across the chest, the tail with five black bands and a white tip.

According to the writer above quoted, the food of the harpy in southern Mexico is very varied, for he “attacks and kills heavy old turkey-cocks, young fawns, sloths, full-grown foxes and badgers, middle-sized pigs, and even the black sapajou monkey (*Ateles paniscus*), whose size and weight exceed its own more than three times. He shows a great latitude of taste, and seems to devour with equal relish a fat iguana lizard, a young woodcock, or a tough old monkey. He can catch fish, too; does not disdain the black water-snakes that glide through the shallow ponds of the coast jungles, and even anticipates the trick of the tortoise-hunters, that uncover the oily eggs which the caret turtle has covered with the sand of the shallow river banks.

“But during the larger part of the year he seeks his quarry on the trees of his native woods, and causes more distress and dire commotion among the tribes of the gallinaceous tree-birds, raccoons, frugivorous rodents, and monkeys than all their other enemies taken together. His tyranny over the kingdom of the air tolerates no rival; the falcons and the *Aquila chrysaëtos* have to confine themselves to the icy rocks of the upper Sierra, the *Strix bubo* and other owls are bound under heavy penalties to keep the peace during daylight, and the sea-eagle is pursued for miles with implacable fury whenever he ventures to trespass upon the rivers of the *tierra caliente*.” Of the breeding habits of this remarkable bird our author gives the following account: “As soon as the lengthening days of the year approach the vernal equinox, the hen harpy begins to collect dry sticks and moss, or perhaps only lichens, with a few claws’ full of the feathery bast of the *Arauca* palm, if her last year’s eyrie has been left undisturbed. Her favorite roosting-places, the highest forest trees, especially the *Adansonia* and the *Pinus balsamifera*, and the more inaccessible rocks of the foot-hills, are commonly also chosen for a breeding-place; and it is not easy to distinguish her compact-built eyrie on the highest branches of a wild fig-tree from the dark-colored clusters of the Mexican mistletoe (*Viscum rubrum*), which frequents the same tree-tops. The eggs are white, with yellowish-brown dots and washes, and about as long, though not quite as heavy, as a hen’s egg. Of these eggs the harpy lays four or five, but never hatches more than two; or, if the Indians can be believed, feeds the first two eaglets that make their appearance with the contents of the remaining eggs. The process of incubation is generally finished by the middle of March, if not sooner; and from that time to the end of June the rapacity of the old birds is the terror of the tropical fauna, for their hunting expeditions, which later in the year are restricted to the early morning hours, now occupy them for the larger part of the day. From the garden-terrace of *El Pinal*, — a little villa on the ridge of the Organos mountains, — I frequently watched a pair of harpies that had their nest in the crags below. The hen bird, which could be recognized by her larger size and the greater energy of her movements, generally made her appearance a few minutes before sunrise, mounted to the upper sky, as if to study the meteorological probabilities for the coming day, and then proceeded to business. After wheeling at an elevation of some hundred feet over the tree-tops in a circle, or rather in a contracting spiral, for a couple of minutes, she commonly would stop short, hover with quivering wings for a second or two, and then dive into the leafy ocean below, with a headlong rapidity that could hardly be followed by the eye, but evidently with a practical purpose, for her descents

were generally succeeded by the ascent of a cloud of birds, or the shrill piping of the squirrel-monkeys (*Callithrix sciurus*), and the exultant scream of the wild huntress from the depths of the forest. Then followed a pause, devoted to domestic duties, during which the thanksgiving duet of the eaglets ascended from the cliffs, and very soon after one or both parents reappeared in the upper air to resume the work of destruction. The callow harpies, with their pendant crops, their misshapen, big heads, and their preposterous claws, resemble embryo demons or infantine chimeras, rather than any creatures of nature; but they grow very rapidly, and their appetite during the first six months of their existence, is almost insatiable.

"The Incas and Aztec noblemen trained harpy-eagles like falcons, and preferred them to tame panthers, which were used by pot-hunters to capture deer and young peccaries. Devega, the biographer of Cortez, says that the satrap of a Mexican province presented the Great Captain with a hunting-eagle called *El Hidalgo del aire*, the prince of the air, whose value was estimated at the price of ten slaves; and adds, that the only bodily injury which Cortez ever received, during his adventures in Mexico, was inflicted by this eagle," which, dying from a wound inflicted by Cortez in a fit of passion, "before he resigned himself to death, raised his head once more, grabbed the first finger of the right hand of his cruel master, and bit it through, — crushed it completely, 'so as not to leave the world unavenged,' as Devega says."

The range of this species is from southern Mexico southward over all the tropical forests of America, — as far, at least, as Bolivia and southern Brazil.

Turning now to birds which more nearly conform to our idea of buzzards, we may mention the genus *Urubitinga* (in which we include *Leucopternis*), a group peculiar to tropical America, whence about a dozen species are known. They are good-sized buzzards, which at once suggest the *Buteones* by their size, proportions, and habits. Among them are some very beautiful birds; for example, *U. ghiesbreghtii* of Mexico, which is snowy white with the exception of wings and tail, which have bold markings of deep black. *U. anthracina*, the anthracite-buzzard of Cuba, Central America, and southward, is the very opposite of this species as regards color, being deep black all over, with the exception of a broad white band across the middle of the tail, and a narrow white edging at its tip. This bird has been taken in Arizona.

Other American genera, closely allied to the foregoing, but which we have only space to mention, are *Asturina*, *Buteogallus*, *Buteola*, and *Busarellus*, — this last being remarkable for the long-hooked bill, as well as for having the soles of the feet thickly studded with rough papillæ or spicules in the manner of the osprey, — evident adaptations for the better catching of fish, which constitute its ordinary food. Gruber's buzzard (*Onychotes gruberi*), is interesting, not only for its peculiarities of structure — which leave it without near relatives among the buzzards — but because only two specimens have ever been discovered, both probably taken in California. "The elongated legs, reaching considerably beyond the rather short tail, the close thigh-plumes, the long and extremely acute claws (somewhat like those of *Rostrhamus*), with the short, rounded, and very concave wing, are its most striking peculiarities."

The genus *Archibuteo*, consisting of only two species, resembles the typical buzzards (*Buteo*) in nearly all points but one, namely the feathering of the tarsi, for these differ from those of all others of the sub-family, except *Aquila*, in being densely feathered in front to the very base of the toes; the hinder aspect of the tarsus, however, is entirely unfeathered. The wings are also proportionally longer than in *Buteo*, in this respect also resembling the genus *Aquila*. Both species are found in North

America, — the squirrel-hawk, or ferrugineous buzzard (*Archibuteo ferrugineus*), being confined to the western side of the continent, while the rough-legged buzzard (*A. lagopus*) reaches from Atlantic to Pacific, and is found in Europe as well. In its normal plumage it is generally ashy-brown, with various lighter and darker markings, and a tendency to form a dark zone across the lower breast and abdomen, while the tail is largely white toward the root. But melanism is of very frequent occurrence, and in this condition the bird is almost entirely black. After much controversy, and



FIG. 136. — *Archibuteo lagopus*, rough-legged buzzard.

many years of uncertainty, it is now definitely settled that this black phase is entirely independent of age, sex, or locality, though it is well to note, in this connection, that in Europe, where the light-colored bird is abundant, black individuals are of extremely rare occurrence, only one or two such being on record.

In America, the rough-legged buzzard seldom nests as far south as the United States, but from the plains of the Saskatchewan northward it breeds abundantly, commonly placing its bulky nest in trees, but sometimes on cliffs, or even at the edge of

a precipitous mud-bank on the border of a stream or lake. The eggs vary in number from three to five, and are of a creamy-white color, sometimes with faint and obscure darker blotches, usually quite heavily marked with spots and dashes of brown.

The last group of this sub-family which we shall take up is the genus *Buteo*, which includes the true buzzards, the number of which varies according to the estimates of different authorities as to varieties and geographical races. Probably there are at least twenty-five well-marked species distributed in all parts of the world, except Australia, and perhaps half this number are found in America.

The common 'hen-hawks' (*Buteo borealis* and *B. lineatus*) of the eastern United States are familiar examples of the genus, and represent about the average size. Their



FIG. 137. — *Buteo vulgaris*, common buzzard.

habits are too well known to need extended description, and they may be seen, summer or winter, sweeping in graceful curves over the country, rising and falling in spirals, unless after noting prey, when they sometimes dart down hundreds of yards in a very few seconds. Although they feed much on birds and rabbits, and are frequent visitors to the farm-yard, they seem to have a special predilection for squirrels; and in regions extensively wooded with pines, where the red-squirrel is most abundant, these noisy little rodents must form a large part of the Buteo's food.

Probably the white-tailed buzzard, *B. pterocles* (*albocaudatus*) of South America represents nearly the maximum size in the genus, its length being about two feet, the wing eighteen and one half inches, and tail seven; but females of the African and Himalayan *B. ferox*, which is not uncommon in south-eastern Europe, sometimes

exceed this size, the tail especially being longer. If now we take the broad-winged buzzard (*B. pennsylvanicus*), only sixteen inches long, wing eleven inches, and tail seven, we have about the minimum.

The type of the genus is the common buzzard (*B. vulgaris*), of Europe, now quite scarce in Great Britain, and entirely confined, as a resident, to a few large wooded tracts. In northern Africa and eastern Europe it is replaced by the smaller African buzzard (*B. desertorum*), probably only a geographical variety of *vulgaris*. In America, too, a species (Swainson's buzzard, *B. swainsoni*), is recognized, which is very near the European *vulgaris*, if not actually the same. Like some other North American Falconidæ, it has a large range, occurring under one name or another from the Arctic Ocean to Patagonia. Nearly all the species of this large genus are more or less subject to melanism, a good example of a rather stable race of this kind being the western form of the red-tailed hawk (*B. borealis*), known usually under the subspecific title of *calurus*, a buzzard of very different appearance from the eastern type, but specifically identical, as shown by the intermediate forms, which show every possible gradation. Such cases as these, coupled with the great differences due to age, and the wide individual variations, have brought confusion little less than hopeless into our lists.

Although but one species of osprey (*Pandion*) probably exists, yet its peculiarities warrant its separation from the eagles, with which it has usually been associated, and necessitate the formation of a sub-family (Pandioninæ) for its reception. This may be characterized as follows: Outer toe reversible, all the toes without basal webs; superciliary shield rudimentary; tibia long, closely and evenly feathered; plumage without aftershafts. As there is but one genus, with a single species, the following characters may be added without attempting to grade them: The bill is strong, toothless, but with a very long, sharp hook; the tarsus reticulate, feet very large, toes with the under surface roughened by close-set papillæ; all the claws of the same length, (unique among Falconidæ), long, much curved, and extremely sharp, not grooved beneath, but smooth, and nearly round, the middle one channelled on the inside. Feathers rather harsh and stiff; wings long and pointed; tail rather short.

It is difficult to imagine a hawk or an eagle better fitted for its trade than is the well-known fish-hawk or osprey. The plumage is such that the bird may remain immersed for several seconds in the water without wetting the feathers, and the powerful wings enable it to rise lightly after its plunge, and lift with ease the slippery prey which is helpless in the grasp of the marvellously perfect feet.

The osprey is found in almost all countries of the globe, but as yet it is not known to occur in Iceland or New Zealand. It breeds, however, in such widely separated places as Hudson's Bay and the Red Sea, Kamtschatka and Florida. The habits of the bird seem to vary somewhat in different countries, and through persecution in some places, or peculiarly favorable circumstances in others, the location of the nest varies considerably. All along the Atlantic seaboard of the United States it breeds abundantly; and the nests, conspicuously placed on the tops of large, dead trees, are visible from long distances, and where the species is abundant several nests may frequently be seen from the same point. Indeed, instances are known of scores or even hundreds of pairs nesting close together, and in organized communities.

The European bird, on the contrary, is nowhere abundant, being usually met with only singly or in pairs, and much more frequently about fresh water than along the seashore. In Great Britain the bird is now rarely met with, except as a straggler,

though a few pairs are still known to breed each summer on some of the least frequented Scottish lakes. But the secret of these localities is jealously guarded by the possessors, as the eggs are among the most coveted prizes of the British collector, and no hardship is too great to be endured in obtaining them.

In Europe this species usually nests on cliffs or rocky islets in fresh-water lakes, rarely on trees, while in America precisely the reverse is true of it. The eggs are from two to four — usually three — generally so heavily blotched with deep brown and red as almost to hide the lighter ground-color. The European bird is rather smaller than the American, and there is a corresponding difference in the size of the egg.

The food of the osprey consists almost entirely of fish, which it catches for itself, usually by a headlong plunge. I am not aware that any particular species is preferred, but the smaller sizes are undoubtedly oftenest captured. It is said that occasionally an osprey miscalculates the size of its prey, and strikes its talons into a fish which it is unable to manage — in which case, being unable to withdraw them [?], it is ignominiously drowned. The pictures, therefore, which one often sees, representing this bird seated triumphantly on a dead salmon of a weight apparently of fifteen or twenty pounds, which it has incidentally transported to a convenient mountain-top, are presumably artistic licenses, — not photographs.

The long and closely feathered tibia, the reversible outer toe, long and peculiar claws, and roughened soles, seem perfectly adapted for effective fishing; and when we add to this the strength of wing, compactness of plumage, and remarkable power of sight possessed by this bird, we must admit that here is indeed a "complete angler" in one volume.

The harriers, *Circinæ*, form a small group of slender, graceful, non-arboreal *Falconidæ*, which may be further described as having the bill rather weak, without any notch, but with the tomia usually strongly sinuate. The legs are long and rather weak, the tarsus about as long as the tibia, unfeathered, and scutellate both in front and behind; the toes are rather short, and the claws, though of no great size, are very sharp; the wings and tail are long, the former straight and but slightly concave, thus giving an easy, gliding flight which the birds seem able to keep up indefinitely, or at least until they strike something worth stopping to eat; the plumage is soft and loose, and the face has an imperfect ruff, which faintly suggests the owls.

The sub-family consists essentially of the genus *Circus*, which is probably indivisible into larger groups than species. Of these there are from ten to twenty, — at present we have not the material to say with certainty how many there may be. Usually the sexes are unlike in color (quite unusual among *Falconidæ*) and size, the females being larger and darker; and the young also differ materially from the adults, though in a general way resembling the females. Add to this the wide range of some species, with the resultant climatic variation, and the determination of species becomes a problem of no ordinary difficulty.

North America has but one species, the marsh hawk or harrier, *Circus cyaneus* (*hudsonius*), now considered to be a mere geographical race of the common hen-harrier, *Circus cyaneus*, of Europe. The North American form is abundant in suitable localities; that is, rather flat open country, from the Arctic circle to Panama, southward from which point, as far as La Plata, it is replaced in similar situations by a larger and totally different species, *C. maculosus*, when we again meet with a variety of *cyaneus* — slightly smaller, perhaps, than the northern form, yet doubtless specifi-

cally the same—to which the name *cinereus* is usually applied. This form, with *maculosus*, abounds on the pampas and plains of Patagonia as far as the strait of Magelhaen, and also occurs, without *maculosus*, in the Falkland Islands.

All the harriers are remarkably similar in habits, preferring comparatively level, open country, and with a fondness for wet grounds. They rarely rise to any great height in the air, being usually content to sweep along close to the ground, now gliding for several minutes with scarcely a motion of the wings, then flapping vigorously for an instant, turning and returning and quartering the whole ground, ever watching for frog or mouse or sitting bird, and following each discovery by a rapid dart, or a drop and clutch, which is usually effective. Ordinarily the feet are not visible at such times, but sometimes the bird fails to make a capture, and, recovering itself before touching the ground, you may see the dangling legs quickly drawn up to the body again. The expanse of wing is unusually large for the size of the body, a specimen which spreads four feet from tip to tip seldom weighing more than a pound or a pound and a half. The nest is almost invariably built on the ground, and the eggs, three to five in number, are nearly white, either faintly blotched and spotted, or immaculate.

Three species are generally credited to Europe; one has been mentioned already, a second is the ash-colored or Montague's harrier, *C. cinerascens*, and the largest is the so-called marsh harrier, *C. æruginosus*.

Jardine's harrier, *C. assimilis*, of Australia, is noteworthy for its deviation from the ordinary coloring in the group, the head and much of the upper parts being dark chestnut with deep black streaks, while the under parts are bright rufous, sprinkled all over with round white spots.

Associated with the harriers by many authors we find a single long-legged, long-winged, slenderly built bird of South Africa and Madagascar, to which the generic name *Polyboroides* has been given, from its superficial resemblance to the caracara (*Polyborus*) of America. The strong bill with the naked skin about its base, and extending back around the eyes, does indeed suggest the face of *Polyborus*, but other points in structure and habits seem to ally it more nearly to the harriers.

Under the head of kites are usually included twenty or thirty species of Falconidae, of most parts of the world, principally from the warmer regions. Although generally recognized as a sub-family, the elements contained in it are very dissimilar, some of the members showing Buteonine tendencies, while others suggest the falcons. Compare, for example, the European black kite, *Milvus migrans*, with the fish-eating eagle, *Haliastur indus*, of India, often called the red-backed or Brahminy kite; also the Mississippi kite, *Ictinia subærulea*, with any species of typical falcon.

In general the kites are very long-winged and small-footed Falconidae, with a short and not very strong bill, which is never truly notched like a falcon's, though the approach to it is sometimes quite close. In addition, the superciliary shield is very variable, being small or almost wanting in the more typical genera, but evident or even prominent in others. The tarsus is much shorter than the tibia, generally more or less feathered, and the exposed portion reticulate. The toes are short, but the claws are sometimes lengthened and always sharp. The wings are usually narrow and pointed, and the tail varies from square to emarginate, and often very deeply forked. Kites are birds of very strong flight; many of them feed largely on insects, and eat their prey from their claws while flying. Not unfrequently they are gregarious, especially during their migrations.

The true kites are limited to the Old World, where they are represented by half a

dozen species of the single genus *Milvus*, of which the common or red kite, *Milvus iclinus*, is the type. This is a bird of comparatively small body, but with wide-spreading wings, and long, deeply-forked tail; the female, which is largest, measuring about twenty-seven inches in length, and having an expanse of wings of over five feet. The general color is reddish brown streaked with black, the tail being rather lighter red, barred with deep brown. These tail feathers are in considerable demand for use in the manufacture of salmon flies.



FIG. 138. — *Milvus migrans*, black kite, and *M. iclinus*, common kite.

This species was formerly one of the most familiar of British birds of prey, having, it is said, been abundant as a scavenger in the streets of London three or four hundred years ago; but, according to Professor Newton, it is now one of the rarest, being restricted to a few wooded districts, where a small remnant still exists. The same authority says Wolley has well remarked of the modern Londoners that "few who see the paper toys hovering over the parks in fine days of summer have any idea that the bird from which they derive their name used to float all day in hot weather high over the heads of their ancestors."

Another European species is the black kite, *Milvus migrans*, which also extends all over Africa. This is of smaller size, darker plumage, and the tail is less deeply forked. Other species are the Arabian kite, *M. aegyptius*, of Africa, and the pariah kite, *M. govinda*, of India. These four are all quite similar in general appearance and habits. They are very active birds, spending much of the time on the wing, feeding principally on small mammals, reptiles, and insects, to which diet several species add fish, while all are much addicted to such refuse as may be picked up about human habitations. Indeed the pariah kite of India does valuable service of this kind directly in the towns and villages of the country, earning thus its common name of village kite. In catching fish and frogs, a favorite habit of the black kite, the bird glides down to the water and seizes with a thrust of the foot one which has risen to the surface, rarely if ever plunging into the water in the manner of the osprey. *Milvus isurus* is a very closely allied but crested form, inhabiting Australia.

Turning now to the less typical members of the sub-family, we may notice first the beautiful little black-winged kites (*Elanus*) of the warmer parts of both Old and New Worlds. Several species are usually recognized, but all are so similar to each other that it would be difficult to discriminate between them at gunshot range. They are seldom more than fifteen inches in length, of which nearly half is tail, and the body color is either white or very light gray, sometimes silvery or pearly, while the shoulders are always black. They feed mostly on insects and some of the smallest reptiles and mammals. The black-winged kite, *Elanus caeruleus*, of Africa and southern Europe, may be taken as the type. The only American species is the very similar white-tailed or black-shouldered kite, *Elanus leucurus*. A very different yet related bird is the Mississippi kite, *Ictinia subcaerulea* (*mississippiensis*), which is rather smaller, and readily distinguishable by the decidedly darker general color, with the larger part of the wings and tail black, the latter with spots on the inner webs of the feathers.

Unquestionably the most beautiful bird of the group is the swallow-tailed kite, *Elanoides forficatus*, of the warmer parts of America, extending up the Mississippi valley even to Minnesota. The beautiful black and white plumage, extremely long and slender-pointed wings, and deeply forked tail, suffice for the recognition of this bird at a single glance. It is one of the two largest American kites, its length from bill to tip of tail being about two feet, while the wings expand rather over four feet. The head, neck, and entire under parts are pure white; the back, wings, and tail, lustrous black; the rump with a white patch. Its flight is unrivalled in swiftness and grace, and it usually takes its prey, consisting largely of insects, on the wing, tearing and swallowing it as it flies. Occasionally, however, when capturing a snake or lizard, it may be seen to alight for an instant. It nests in trees, laying several spotted eggs, but these are rare in collections, and the nesting habits of the species are but imperfectly known. It frequently associates in large numbers, while feeding on insects and while migrating, and there is some reason to suppose that it may occasionally breed in communities, though during the breeding-season it is usually met with only in pairs.

While traveling among the mountains of Guatemala, Mr. R. Owen observed a large flock—more than two hundred—of these birds engaged in the pursuit of a swarm of bees, which they caught singly with their feet, and, bringing the foot forward and bending the head downwards and backwards to meet it, they easily and rapidly transferred the prey to the bill.

A closely allied, fork-tailed species is the *Naucleus riocouri* of west Africa, a bird

of very similar form and habits to the swallow-tail, but much smaller and of less striking appearance, the upper parts being merely ashy and dusky, entirely lacking the deep black so conspicuous in the American bird.

In the kites thus far mentioned, the bill is comparatively short and broad, though not particularly strong. There is a group of American kites, however, which are very different from these, and in which the bill is lengthened, slender, and with a remarkably long and sharp hook. The hook-billed kite, *Rostrhamus hamatus*, of South America, is a good example of the group, and appears to have precisely the same habits as its somewhat more northern relative, the everglade-kite, *R. sociabilis*, which



FIG. 139. — *Ictinia subaerulea*, Mississippi kite, and *Elanoides forficatus*, swallow-tailed kite.

occurs in some numbers in the Everglades of Florida. These birds seem to be unusually sociable for birds of prey, several being usually observed together, but it is questionable if this habit is more strongly developed here than in other species of the *Milvinae*.

Perhaps the most interesting thing in connection with the present genus is the entirely unexpected nature of its food. We should naturally expect a bird of this conformation to take much of its food on the wing, and should be prepared to find that winged insects or active reptiles, such as lizards, made up the bulk of it, although neither of these suppositions would provide an adequate explanation of the long-

hooked bill or the long-clawed feet. It is, therefore, not a little disconcerting to find these rapid and expert flyers preying chiefly on some of the slowest of existing animals, namely, fresh-water snails. In Florida, Mr. Maynard found that their food consisted largely of *Pomus depressus*, while on the Rio Uruguay I found them eating a species of *Ampullaria*, and at one time shot a specimen as he circled overhead with a large mollusc of this kind in his claws. Having observed the facts, it is easy to see the adaptation of the long, slender hook with which the bill is provided, as well as the use of the sharp and lengthened but slightly curved claws; while we have an example of the uncertainty which may attend that kind of reasoning from structure to function, which is, unfortunately, too often depended upon.



FIG. 140. — *Pernis apivorus*, bee kite.

Allied to *Rostrhamus* are the species of the American genus, *Cymindis*, which pass through so many changes of plumage, and are so perplexing in their variations that it would seem unwise for any person without scores or even hundreds of specimens before him to venture an opinion as to the actual number of species or geographical races. The genus is restricted to tropical America, and one species, *C. cayennensis*, is the largest of the New World kites, approaching the dimensions of *Milvus ictinus* of Europe.

The honey-buzzard or bee kite, *Pernis apivorus*, inhabiting Europe and Africa, and ranging from the Arctic Circle to the Cape of Good Hope, is a bird which has characters allying it both to the buzzards and to the kites, while in many points it differs so decidedly from either that not a few ornithologists make it the type of a distinct sub-family, *Perninæ*.

In its general form it resembles the *Buteoncs*, but is more slenderly built, and has a longer tail, in both of which respects it resembles the kites. The sides of the head, however, are softly and densely feathered to the very base of the bill, in this respect differing entirely from most members of both these groups, though we see an approach to this character in *Elanoides*. It gets its name of honey-buzzard from its habit of digging up or breaking open the nests of wasps and bees, on the larvæ of which it delights to feed, and in the gathering of which the densely feathered head is proof against the stings of the infuriated insects. It probably also enjoys the honey, which it certainly eats, for large quantities have been found in its stomach, accompanied by but very few larvæ, though it has usually been supposed that the honey was only eaten by accident with the young bees. This fondness for larvæ is not satisfied with bees alone, for the bird eats larvæ of various other insects, as well as worms, small reptiles, and mammals, and has even been found gorged with maggots, which were obtained from the carcass of a dead animal. It also robs the nests of the smaller birds, and is much persecuted by them in consequence.

It is a migratory species, spending the winter in Africa, and moving northward in the spring, frequently traveling in large, loose flocks. Of these migrations as observed at Heligoland,—that little rock in the North Sea so famous as a resting-place for tired migrants,—Mr. J. Cordeaux tells us “Mr. Gätke says this is by far the most common of the buzzards, not, however, appearing in the spring before it really has become warm, returning southward again in August and September. Besides single specimens, and two and three at a time, there are during both periods of migration, not very unfrequently, such flights that they may almost be termed thousands, not all massed together, but passing over from mid-day to evening in batches of from five to fifteen, or twenty to fifty, one following the other so closely that the first batch is not out of sight before the third or even the fourth begins to show already. The vernal migration takes place about the latter part of May, or a little earlier, on warm days with a calm clear sky and easterly wind.”

Contrary to the general rule among birds of prey, it is very late in nesting, its eggs being seldom laid until the young of other hawks and buzzards are hatched or even half grown. The nest,—frequently the deserted one of another kite,—is placed in a tree, and in it two or three beautifully marked eggs are laid. These have long been counted as special prizes by European collectors, and perhaps it is largely owing to this demand for its eggs that the species has of late years ceased to breed abundantly in places where it formerly did so. By the time the nest is built, the oaks and beeches are in full leaf, and the nest consequently difficult to find, and its safety is still further assured by a curious habit of the birds themselves, which leads them to line and decorate the nest with an abundance of fresh green leaves, which they renew as fast as they become faded. This is done first before the eggs are laid, and is kept up sometimes until after they are hatched, though more commonly only for a short time after laying. One or two other species of this genus are known.

The sub-family Polyborinæ, carrion-buzzards, is a small group of eight or nine species, all confined to America, and only two of them found above Panama. In their habits they combine characteristics of the New World vultures with those of ordinary buzzards and eagles. Structurally they are easily separable from both, and although externally they suggest the Aquilinæ, Ridgway has shown that osteologically they are nearer the falcons.

They may readily be recognized by the webbing between the toes, this being found

between the inner and middle toe, as well as between outer and middle, as in most other Falconidae except the osprey. In addition to this, the bill is not usually toothed (the only exception being in *Milvago*, where there is a trace of a tooth); the legs are rather long, tarsi little feathered in front above, mostly reticulate, or with small scales, only really scutellate just above the toes, in front; the hind toe much shorter than any of the others, which are variable in length. The sides of the head are also more or less destitute of feathers. Two or three of the species reach the size at which most buzzards gain popular recognition as eagles, but the others are smaller.

The species have been rather naturally grouped in three genera, namely, *Polyborus*, with one or two species, *Milvago*, with five or six, and *Ibycter*, with two. *Polyborus* and *Milvago* are chiefly terrestrial; *Ibycter* completely arboreal. The legs in all are decidedly long, the toes short in the terrestrial forms, longer in the arboreal. The bill of *Polyborus* is much the strongest, being high, laterally compressed, and with narrow, almost linear nostrils, while the other genera have the bill of a more ordinary type, and the nostrils circular. In all the genera there is a patch of naked skin over the crop, not noticeable, however, while the crop is empty. There is also more or less unfeathered and often brightly colored skin about the face. This is least noticeable in *Milvago chimango*, more prominent in the other species of *Milvago* and in *Polyborus*, and reaches its maximum in *Ibycter americanus*, where not only the face and sides of head are bare, but also a large part of the throat.

The caracara eagle, *Polyborus tharus*, is an abundant bird all over South America, and one of its races extends as far north as Texas and Florida. It is strongly and rather clumsily built, spending much of its time on the ground, where it walks about easily in search of food. On the wing it does not usually give the impression of much strength or skill, but it does often rise to a great height, and during the pairing season frequently goes through a variety of aerial evolutions. It feeds on animal matter of any kind, freshly killed or putrid, is often seen associating with the vultures (*Cathartes*), and, like them, not unfrequently attacks weak or sickly animals. On the plains of La Plata it is hated and detested by the sheep farmers for its habit of attacking new-born lambs, many of which, in spite of every precaution, are annually killed in this way. Darwin says of this species: "Their vulture-like, necrophagus habits are very evident to any one who has fallen asleep on the desolate plains of Patagonia, for when he wakes he will see, on each surrounding hillock, one of these birds patiently watching him with an evil eye. . . . At times the carrancha is noisy, but is not generally so; its cry is loud, very harsh, and peculiar, and may be likened to the sound of the Spanish guttural *g*, followed by a rough double *r*; when uttering this cry it elevates its head higher and higher, till at last, with its beak wide open, the crown almost touches the lower part of the back. This fact, which has been doubted, is quite true; I have seen them several times with their heads backwards in a completely inverted position." To this we may add that although this last singular fact is confirmed, if confirmation were necessary, by many other observers, it can scarcely be a very common performance, since we ourselves, during an uninterrupted acquaintance of about eighteen months with this bird, never saw more than a slight elevation of the head while its cry was uttered.

It makes a bulky nest on low or medium-sized trees, and lays two or three handsome, brown-spotted eggs, very variable in precise color and amount of markings. The general color of the caracara, or *carrancha*, as it is called on the Plata, is blackish brown above, with fine cross-bars of black and grayish white below. The

crown of the head is dull black, the bill variable, but usually bluish white, the cere and bare space about the eye, orange-red. The northern race (*auduboni*) seems to differ but little in habits or appearance from the southern bird, but perhaps the plumage is rather less barred.

In *Milvago* we have a very different bird, though the habits vary considerably, according to species and locality. Most of the species are much smaller than the caracara, and decidedly more active. When food is scarce, they may be seen on the wing almost all day, sweeping about from place to place, often hovering in the



FIG. 141. — *Polyborus auduboni*, caracara.

manner of kites and buzzards, or walking about on the ground like so many crows. They are almost completely terrestrial in habits, sometimes even nesting on the ground.

The chimango, *Milvago chimango*, the smallest species of the genus, is the common bird of southern South America, and especially abundant from Paraguay southward. Further north it is replaced by *M. chimachima*, while in the Falkland Islands a much larger species, *M. australis*, is common. Of this latter species, Mr. Darwin says: "They live on the flesh of dead animals and on marine productions; and on the Ramirez rocks their whole sustenance must depend on the sea. They are

extraordinarily tame and fearless, and haunt the neighborhood of houses for offal. If a hunting party kills an animal, a number soon collect and patiently await, standing on the ground on all sides. After eating, their uncovered craws are largely protruded, giving them a disgusting appearance. They readily attack wounded birds; a cormorant in this state, having taken to the shore, was immediately seized on by several, and its death hastened by their blows.



FIG. 142.— *Miteago australis*, and *M. chimachima*, chimachima.

"The Beagle was at the Falklands only during the summer, but the officers of the Adventure, who were there in the winter, mention many extraordinary instances of the boldness and rapacity of these birds. They actually pounced on a dog that was lying fast asleep close by one of the party; and the sportsmen had difficulty in preventing the wounded geese from being seized before their eyes. It is said that several together (in this respect resembling the carranchas) wait at the mouth of a rabbit-hole, and together seize on the animal when it comes out. They were constantly flying on board the vessel when in the harbor; and it was necessary to keep a

good lookout to prevent the leather being torn from the rigging, and the meat or game from the stern. These birds are very mischievous and inquisitive; they will pick up almost anything from the ground; a large, black glazed hat was carried nearly a mile, as was a pair of the heavy balls used in catching cattle. Mr. Usborne experienced during the survey a more severe loss in their stealing a small Kater's compass in a red morocco leather case, which was never recovered. These birds are, moreover, quarrelsome and very passionate, tearing up the grass with their bills from rage. They are not truly gregarious; they do not soar, and their flight is heavy and clumsy; on the ground they run extremely fast, very much like pheasants. . . . It is a curious circumstance that when crying out they throw their heads upwards and backwards, after the same manner as the carrancha."

The species of *Ibycter*, two in number, are inhabitants of the heavily wooded country of tropical South America; the smaller species, *Ibycter ater*, apparently not extending north of Panama, while *Ibycter americana*, approaching the caracara in dimensions, is found in Guatemala and Honduras as well. The plumage in both species is simple black and white, the black with greenish reflections. In *ater*, this includes the entire plumage except a white band at the base of the tail. In *americana* the colors are "black with steel green reflections, the abdomen, thighs, and under tail-coverts white; throat and bare space before the eye, deep red; cere, blue; mandibles, yellow; iris, deep red." These birds keep by preference to the trees, and are said to feed largely on insects instead of carrion.

The hawks, Accipitrinæ, might be defined as those Falconidæ, except true falcons, not already described, and differing from the true falcons in not having a toothed or notched bill. Or, we might say that they were very much like the harriers, Circinæ, as to bill, body, tail, and perhaps legs; but with very different wings. But, to be more explicit, the birds which we group here under the name Accipitrinæ, agree with the harriers in the slender form, weak and un-toothed bill, long tail and legs, tarsus about the same length as the tibia, and superciliary shield prominent. The absence of the facial 'ruff' would at once separate them from the Circinæ, but an equally important difference, not only from the harriers but from the falcons and buzzards, is seen in the wings, which instead of being long, straight, and tapering, as in the harriers and falcons, or broad, flat, and obtuse as in the buzzards, are short and rather rounded, but very concave beneath, so that their flight is rapid and almost 'whirring,' without the power of lofty soaring or of long continued and easy gliding. The cutting edge of the bill is also usually furnished with a prominent lobe or 'festoon;' the middle toe is often very long, the 'pads' under the joints on all the toes very strongly developed; and the tarsal envelope very various, usually more or less feathered, and the bare part scutellate in front or behind or both, sometimes with the plates fused together to form a 'booted' tarsus (as in the true thrushes), or even in some cases partially reticulate.

. . The hawks, while numerous individually and even specifically (there are sixty or seventy species), are all contained in a very few genera, probably nine tenths of them in the genera *Astur* (goshawks), and *Accipiter* (sparrow-hawks). The distinctions between these two groups, moreover, are very slight, so slight indeed that there are very many species which to ordinary eyes seem to have as good a right under one name as the other. In general, *Astur* contains the larger and especially the stouter forms, in which the tarsus is more extensively feathered. There are, moreover, other points, such as the condition of the tarsal envelope, which should be taken into ac-

count. As an illustration of the lack of uniformity among systematists with regard to these genera, it may be mentioned that of two prominent authorities who published their views at about the same time (1874), one refers but six species to *Astur*, while the other includes thirty-one. The latter author, however, allows but twenty-three species to the genus *Accipiter*, while the former admits forty-five. For our present purposes it makes little difference which we follow in this respect, though there seems to be little doubt now that only a few species ought to be included among the goshawks. The word goshawk is evidently only a corruption of goose-hawk, and though



FIG. 143. — *Astur palumbarius*, goshawk.

now only applied to birds of the genus *Astur*, it seems probable, as Professor Newton remarks, that it was originally given to one of the large true falcons, which might reasonably be supposed to prey on geese, as such game is evidently beyond the capacity of *Astur*.

The goshawk of the northern United States, *Astur atricapillus*, is by many believed to be merely a geographical race of the European goshawk, *A. palumbarius*. If so, it is certainly a larger and handsomer form, and in habits the two are very similar. The adult American bird is one of the handsomest of our birds of prey, the whole top of the head being pure, deep black, the rest of the upper parts pure bluish

slate, darkening on the tail; below, the color is pure white, closely and finely barred crosswise with slate. The chin and throat lack the crossbars, but each feather has a dark shaft-stripe, while running backward from above and behind the eye is a broad white stripe finely pencilled with black. The wings and tail are dark, the latter with four or five obscure black bands. The female, which is largest, measures about two feet in length, with a spread of about four feet. Like most of the other members of this group, the goshawk is extremely active and daring. Strong of wing and stout of heart, it is both bold and cunning, and its attack once determined on is usually successful. It is a northern bird, ranging southward in winter, yet doubtless often breeding within the limits of the United States. Audubon says of its habits, —

“The flight of the goshawk is extremely rapid and protracted. He sweeps along the margins of the fields, through the woods, and by the edges of ponds and rivers, with such speed as to enable him to seize his prey by merely deviating a few yards from his course, assisting himself on such occasions by his long tail, which, like a rudder, he throws to the right or left, upwards or downwards, to check his progress, or enable him suddenly to alter his course. At times he passes like a meteor through the underwood, where he secures squirrels and hares with ease. Should a flock of wild pigeons pass him when on these predatory excursions he immediately gives chase, soon overtakes them, and, forcing his way into the very centre of the flock, scatters them in confusion, when you may see him emerging with a bird in his talons, and diving towards the depth of the forest to feed upon his victim. When traveling, he flies high, with a constant beat of the wings, seldom moving in large circles like other hawks, and when he does this it is only a few times in a hurried manner, after which he continues his journey. . . .

“It is a restless bird, apparently more vigilant and industrious than many other hawks, and seldom alights unless to devour its prey; nor can I recollect ever having seen one alighted for many minutes at a time, without having a bird in its talons.

“When thus engaged with its prey, it stands nearly upright, and in general, when perched, it keeps itself more erect than most species of hawk. It is extremely expert at catching snipes on the wing, and so well do these birds know their insecurity, that, on his approach, they prefer squatting.” The goshawk nests in trees, laying three or four bluish-white eggs, rarely faintly blotched and spotted with brown.

In the higher parts of Ceylon and India, and in many of the East Indian Islands, is found the smaller *Astur trivirgatus*, with a conspicuous occipital crest; but the most singular member of the genus is the Australian goshawk, *Astur nova-hollandiæ*, sometimes known as the New Holland white-eagle. This is apparently a permanent albino, for the adult plumage is pure white, the cere, gape, and legs yellow, the bill black, and the iris pink. The young bird is mostly white below and brown above, but nearly all the dark feathers are white at base.

The genus *Accipiter* includes species of mostly small size and slender form, but otherwise remarkably like the goshawks in structure and habits. In England they are known as sparrow-hawks, from the common species, *Accipiter nisus*, which is the sparrow-hawk of the country. In the United States we generally use the name sparrow-hawk for a true falcon; the little *Falco* (*Tinnunculus*) *sparverius*, and the two common species of *Accipiter* are known, the smaller as the sharp-shinned hawk (*A. fuscus*), from the slender tarsi, and the larger as Cooper's hawk *A. cooperi*, or sometimes as the chicken-hawk. They are common, active, graceful birds, preying almost entirely on birds and small mammals, which they rarely lie in wait for and

seize as they pass, more commonly — especially in the case of small birds — chasing and seizing them while on the wing, and then retiring to some neighboring dead tree, or more secluded spot, to dispose of their game.

They nest in tall trees and lay from three to six eggs, those of Cooper's hawk being usually bluish-white and unspotted; those of the sharp-shinned nearly white, heavily blotched and spotted with dark brown.



FIG. 111. — *Accipiter nisus*, sparrow-hawk.

As already remarked, the species of this genus are quite numerous and found in almost every part of the world. Their habits seem to be essentially the same everywhere, and while the tints of their plumage are seldom striking and never brilliant, black, white, slaty blues and red-browns being the commonest, — yet the pattern of coloration always gives a pleasing effect. In size there is no great variation, Cooper's hawk, with a length of less than eighteen inches, being among the largest, while the smallest is probably *A. tinus* of South America, large specimens of which do not exceed a foot in length, while small males measure only about nine inches.

Closely related to the Accipiters, but separated from them and from the goshawks by their shorter toes, tubercled nostrils, and somewhat different condition of the tarsal envelope, are several species grouped under the genus *Micrastur*, peculiar to South America, and similar in general habits to the foregoing; while a small group restricted to Africa has a typical representative in the singing-hawk or chanting falcon, *Melierax canorus*. This bird is nearly as large as a goshawk and with somewhat similar habits, being possessed of great courage, and with the power of very rapid flight, often attacking birds much larger than itself. It is said to feed mainly on birds and small mammals, and to have a habit of hunting quite late in the evening. The most peculiar part of its history, however, relates to its voice; for the male seems to have a true song, which, according to Le Vaillant, consists of decidedly musical notes lasting for as much as a minute at a time and repeated at short intervals for hours together. The song is usually uttered at morning and evening, sometimes however in the middle of the night, always while the bird is perched, usually on a tree in the vicinity of its nest; and although at other times a noisy and suspicious bird, the singer on these occasions is said to become so absorbed in its own music as to be easily approached and shot.

A similar singing habit has been noticed in *Asturina monogrammica*, a much smaller African hawk, and not generally considered to be closely related to *Melierax*, though Mr. Gurney, in communicating the above notice of its vocal powers to the London Zoological Society, has called attention to the precisely similar coloration of cere, bill, and feet, in the two cases, these parts being vermilion red in both birds.

Though certainly not more courageous than some species among the hawks, and not better adapted perhaps for the work they do, yet the true falcons, forming the sub-family Falconinæ, are, by almost common consent, given the place of honor among diurnal birds of prey.

They represent among these the maximum of strength in its most compact and available form. They are not large birds; none approach the eagles in size, and some are among the very smallest of Raptores,—not larger than good sized sparrows; yet their organization makes them the masters of birds three times as large as themselves, while, from the very ease with which their wants are supplied, they remain apparently inactive a large part of the time, and hence often get the credit of a lazy, or at best fitful, disposition. There is little of that feverish restlessness about them which is so characteristic of the hawks, but in its place there is a deliberate earnestness and a stubborn perseverance which we cannot fail to recognize as a higher quality than the fretful snap or brilliant dash of the slender Accipiter. They are easily recognized by their physiognomy.



FIG. 145.—Foot of *Melierax caerulescens*.

The short, strong beak has an acute hook, and the upper mandible is provided near the end with a strong projecting tooth, which shuts into a corresponding notch at the tip of the lower mandible. The only approach to such a toothed bill among other Accipitres is in the genus *Milvago* among the carrion buzzards, already noticed, and in a few forms among the kites, where it never assumes the precise character seen here. The legs are strong and rather short; the tarsus usually reticulate,—never really scutellate either before or behind; the middle toe very long, and the claws

very sharp and much curved; the tail short and of stiff feathers, while the wings are long and very sharply pointed, almost straight, and very slightly convex.

The number of species varies with different authors from twenty-five to seventy-five, depending partly on the status allowed the numerous geographical races, and partly on the personal equation of the author. Probably most systematists would be content with less than fifty.

Taking the peregrine-falcon, *Falco peregrinus*, as the type of the genus *Falco*, and this genus as the typical one of the group, the principal outliers are the genera *Baza*, *Harpagus*, *Hierax*, and *Hieracidea*.

There seems to be a tendency all through the diurnal Accipitres to a lengthening of the feathers of the back of the head, and nearly every group contains some species in which this is more positively expressed in a crest. Even the goshawk, *Astur palumbarius*, shows such a tendency, especially when young; and now in the highest group, the Falconinæ, we find several species gathered into the genus *Baza*, which are conspicuous, in addition to their striking colors and double-toothed bill, for a long and beautiful crest. As an example of this beautiful genus, we may take the crested falcon, *Baza lophotes*, a native of India and Ceylon. The general color above, including the crest and tail, is glossy, greenish black; the wings partake also of this color, but are much variegated with white and chestnut; the upper neck and throat are deep black, while the lower neck, breast, and abdomen are creamy white, with broad crossbars of rich chestnut. With this genus are often associated the very similar kite-falcons, *Avicida*, of Africa.

The South American notched-falcon, *Harpagus bidentatus*, probably also belongs here. It is a crestless form, with double-notched bill (more strongly so than *Baza*), and inhabits the wooded regions of tropical South America. The colors of the adult are slaty blue above, rich chestnut below; the throat white, with a broad median line of dull black.

The tiny finch-falcons, *Hierax*, of the East Indies are, from their small size, among the most marvellous of the falcons. Though only five and one half to six and one half inches in length, they have all the spirit of the larger falcons, and feed largely if not entirely on birds and small mammals. One of the commonest, the Bengal falcon, *Hierax carulescens*, bluish black above and rusty white below, has been seen at a single foray to strike ten or a dozen quail before alighting. Two or three species from the East Indies are described, and another from the Philippine Islands, but they are probably not all tenable.

The sparrow-hawk or quail-hawk of New Zealand, *Hieracidea novæ-zealandiæ*, is a larger species, which, according to Professor Newton, may represent the more generalized and ancestral type from which both kestrels and falcons have descended. *Spiziapteryx circumcinctus*, of the Argentine Republic, is another genuine falcon of small size.

We now come to the genus *Falco*, with the peregrine or duck hawk, *Falco peregrinus*, as its type. Not less than a dozen different races of this bird have been recognized, and most of them described as species, but recent writers incline to the belief that there is but one valid species, which is almost cosmopolitan. Says Professor Newton of this species:—

“From Port Kennedy, the most northern part of the American continent, to Tasmania, and from the shores of the Sea of Ochotsk to Mendoza in the Argentine Republic, there is scarcely a country in which this falcon has not been found. Speci-

mens have been received from the Cape of Good Hope, and it is only a question of the technical differentiation of species whether it does not extend to Cape Horn. Fearless as it is, and adapting itself to almost every circumstance, it will form its eyry equally on the sea-washed cliffs, the craggy mountains, or (though more rarely) the drier spots of a marsh in the northern hemisphere, as on trees (says Schlegel) in the forests of Java, or the waterless ravines of Australia."



FIG. 146. — *Falco peregrinus*, peregrine falcon.

The American race differs slightly if at all in habits from the better known European bird. It flies with great swiftness and without sailing, but when on the lookout for prey rises easily in a spiral to a considerable height, whence it generally launches itself like an arrow directly at its victim, which is usually killed almost instantly by the clutch of the talons, and carried off to be eaten at leisure. When intent on its quarry it becomes oblivious to everything else, and its natural boldness is at all times surprising. It not unfrequently makes its appearance at the report of a gun, and carries off a wounded bird before the astonished sportsman can recover himself. In

America it almost invariably nests on ledges of rocks in precipitous places, rarely making much of a nest, and sometimes laying its handsome eggs on the bare rock, or in a slight hollow scratched in the *débris* of the ledge. These are three or four in number, usually so heavily blotched with chocolate and red-brown as to entirely obscure the ground color, which, when visible, is creamy white.

Although ordinarily nesting as above, it has been known exceptionally to breed in trees, Mr. N. S. Goss having given an account of his observations on several pairs which he found nesting in the timber along the banks of the Neosho River in Kansas. In one case, three eggs were found in a large sycamore, about fifty feet from the ground, "laid on the fine, soft, rotten wood in a trough-like cavity formed by the breaking off of a hollow limb near the body of the tree." Another pair was found nesting in a knot-hole in a cottonwood, and still another in a hollow limb of a giant sycamore.

The general colors of the adult bird are dark bluish ash above, almost black on the head, lighter on the tail. Below, creamy white, barred, except on chin and throat, with black, while a large black patch extends from the bill backward beneath the eye, and downward under the bill. The young are more brownish above, and are streaked longitudinally instead of barred below, said to be a characteristic of all the larger and typical falcons before the first real moult. Another point which some systematists make much of, and which was recognized centuries ago by falconers, is the fact that in all true falcons, the iris is brown, and usually quite dark. This is probably true of all members of the genus *Falco*, including all the sub-genera except *Tinnunculus*, in which group some species have yellow irides. But these yellow-eyed birds differ much from their relatives, and seem to have lost most of the spirit of the true falcons.

The largest and finest of all the falcons are the gyrfalcons, confined to the colder portions of the northern hemisphere. Just how many species there are is still unsettled; some naturalists recognize four distinct but nearly related species; others believe in only a single circumpolar species, in which they consider it difficult if not impossible to distinguish geographical races. The four forms, be they species or races, are certainly very much alike in all but color of plumage, and this is extremely variable even in individuals belonging to the same 'race.'

These forms are thus treated by Professor Newton: "Next to the typical Falcons comes a group known as the 'great northern' falcons (*Hierofalco*). Of these the most remarkable is the gyrfalcon, *F. gyrfalco*, whose home is in the Scandinavian mountains, though the young are yearly visitants to the plains of Holland and Germany. In plumage it very much resembles *F. peregrinus*, but its flanks have generally a bluer tinge, and its superiority in size is at once manifest. Nearly allied to it is the Icelander, *F. islandus*, which externally differs in its paler coloring, and in almost entirely wanting the black mandibular patch. Its proportions, however, differ a good deal, its body being elongated. Its country is shown by its name, but it also inhabits South Greenland, and not unfrequently makes its way to the British Islands. Very close to this comes the Greenland falcon, *F. candicans*, a native of North Greenland, and perhaps of other countries within the Arctic circle. Like the last, the Greenland falcon from time to time occurs in the United Kingdom, but it is always to be distinguished by wearing a plumage in which at every age the prevailing color is pure white. In northeastern America these birds are replaced by a kindred form, *F. labradorus*, first detected by Audubon, and lately recognized by Mr. Dresser. It is at once dis-

tinguished by its very dark coloring, the lower parts being occasionally almost as deeply tinted at all ages as the upper."

The habits of all these forms are, so far as known, essentially the same. They are birds of the Arctic regions, and even in winter do not wander far southward. Holböll states that in Greenland they prey mostly on waterfowl and ptarmigans, nest in inaccessible cliffs in January (!), and lay eggs similar in color to the ptarmigans, but twice as large. MacFarlane, however, who found many gyrfalcons nesting in the



FIG. 147. — *Falco lanarius*, lanner.

neighborhood of Anderson River, says that, out of eighteen nests found, all were in trees except two, one of which was built on a ledge of rocks and the other on the ground on the side of a steep hill. The earliest nest found with eggs was on May 10; but at that time the ground was still covered with snow, and the weather was very cold. The eggs are described as varying much in general color and marking, but are usually of a reddish or yellowish brown, due to the fine and even spotting of these tints on a lighter ground. Heavy spots and blotches are unusual in these eggs.

These northern falcons or gyrfalcons are said to be the only ones which resemble the peregrine in being streaked below while young, and cross-banded when adult.

Another falcon, which much resembles the young of the peregrine, but which is streaked below at all ages, is the lanner, *F. lunarius*, of southern Europe, north Africa, and southwestern Asia. Several well-marked races of this form are found in other countries, for instance the lugger, *F. jugger*, of India, and the prairie-falcon, *F. mexicanus*, of Mexico and the southwestern territories of the United States.



FIG. 148. — *Falco lithofalco*, merlin.

A better-known American bird is the so-called pigeon-hawk, *Falco columbarius*, which occurs throughout the whole of the United States. Though a much smaller bird than the duck-hawk, it is equally bold and fearless, and frequently kills birds heavier than itself. It is very closely allied to, if not identical with, the European merlin, *F. lithofalco*; and these two forms, with the Indian *F. chiquera*, and its African race, *ruficollis*, and a few others, are not unfrequently separated from *Falco*, as a sub-genus *Esalon*, the merlins.

Very close to these are several beautiful species which are similarly grouped together under the sub-generic title *Hypotriorchis*, and of which the English hobby, *F. subbuteo*, is the smallest member. This is an elegantly shaped bird of inconspicuous colors, not distantly resembling a boldly marked, immature peregrine, readily recognized by its (for a falcon) extremely long wings. It has a wide distribution in the old world, being found almost everywhere in Europe, Asia, and Africa. While it fre-



FIG. 119. — *Falco subbuteo*, hobby.

quently captures birds of considerable size, and has even a superabundance of courage and wing-power, a favorite food while in England is large insects, especially beetles and dragon-flies, which it catches on the wing, often hunting the beetles in the evening until it is quite dark.

It is unquestionably one of the swiftest of the falcons, delighting to chase and capture swallows, and frequently striking at and annoying large birds, such as herons and cranes, which it evidently has no thought of attempting to kill. According to

Lord Lilford this species is never seen hovering in the manner of the kestrel, but in summer time it sometimes soars to an immense height and 'lies upon its wings' in bright sunny weather for hours together. The following instance of its sagacity is given in Dresser's "Birds of Europe," on the authority of Mr. C. E. Diezel: "In the seegwald stood a large beech tree, on which was a very large old nest, which although the old birds were regularly shot for eight years, either when the nest contained eggs or when feeding their young, was still tenanted again. One year, when, as the birds were so shy, they could not be approached within gunshot, the forester and a companion took turns about to watch the nest, which then contained young, in order to shoot the parent birds as they came with food. The old birds never came within shot, and still the young were not starved. After a time, however, the watchers discovered that the old birds took food and, hovering far out of gunshot above the nest, dropped it down into the latter, thus feeding the young without danger to themselves. That this really was the case was proved by keeping a careful and continuous watch; and, moreover, food was found under the tree, which had, in falling, missed its mark."

While we would much rather believe than disbelieve, yet there are some elements of improbability about the preceding narrative, and we would suggest that unless the birds were actually seen to feed the young in this way, it would seem less improbable that a bird of well-known crepuscular habits should have chosen the night as a safe time for conveying food to the nest.

Another, but much less common bird, of this group is the beautiful Eleanora falcon, *Falco (Erythropus) eleanoræ*, of the Mediterranean region. The adult in full plumage is very deep blackish brown, sometimes sooty black, with black bill and claws, and bright yellow orbits and feet. Its food, like that of the hobby, consists largely of insects, and it is described as eminently crepuscular in its habits. Certain small islands off the south shore of Sardinia are favorite resorts of this rare species, and on some of them hundreds of pairs breed in caves and fissures of the cliffs.

Yet another and the largest species of this group is the femoral or plumbeous falcon, *F. femoralis*, of South America and Mexico, of whose habits, however, little seems to have been recorded.

The common sparrow-hawk, *Falco (Tinnunculus) sparverius*, of the United States, is too well known to need description. Its nesting habits are singular, as it generally lays its five or six eggs in a deserted woodpecker's hole, or even in a martin-box or dove-cote. This may be taken as the type of a group of beautiful little falcons which have often—perhaps usually—been separated from *Falco* under the sub-generic name *Tinnunculus*, including the European kestrel, *T. abundarius*, and perhaps a half dozen other species. In their relations to man they are probably the most harmless falcons in existence, feeding mainly on mice and insects, though occasionally taking a small bird; and they are so graceful in their motions, so tidy and pretty in their whole appearance, that it is to be regretted they are not more abundant everywhere. The kestrel is indeed the most abundant of all British birds of prey, and its hovering form, as it poises in mid-air on the watch for its prey, is familiar to every schoolboy in that country.

Fifteen or twenty other names have been highly recommended for specific distinction, but it is impossible at present to say just how the honors should be divided. It seems doubtful whether America has more than one species, *sparverius*, with its various races. Africa claims at least three, of which one, *alopea*, is remarkable for its uniform yellowish-red color, with longitudinal dark streaks and black wings.

Madagascar furnishes another peculiar form, and others still are found in the Malay Archipelago and Australia.

Few allusions have purposely been made thus far to the uses of birds of prey in the chase, it being our intention to defer this until most of the species thus used should have been mentioned in their regular places. It is therefore fitting, here, in connection with the group of birds which has given its name to the sport, to devote a few pages to the consideration of that most time-honored of all field sports, hawking or falconry. This, in its broadest sense may be defined as the use of hawks or falcons in the capture of other animals. In strictness, we ought, perhaps, to limit the term to the actual taking of game with hawks or falcons, this being the sense in which it is commonly understood.

Yet trained hawks are still used merely to hover over game and prevent its flying until it can be netted or killed; and eagles or large falcons were formerly much used in parts of Asia and Africa to annoy and hinder gazelles and deer, by flying in their faces, and striking at nose, eyes, or back, thus retarding their flight, and giving time for the hunters and dogs to come up. In one form or another falconry has undoubtedly an antiquity as great as that of the Egyptian mummies, as it is known to have been practiced among the Egyptians centuries before the Christian Era, and certainly flourished in China earlier than 600 B. C., probably existing there over a thousand years earlier still. In Europe, also, it was a favorite pastime before the Christian Era, but it was not introduced into England until about the middle of the ninth century, and for the next eight hundred years was by far the most popular sport practised in both England and France.

Monarchs kept their hawks by hundreds, knights and ladies paid fabulous sums for the best trained birds, and even peasants took to rearing sparrow-hawks and kestrels, and spent their holidays in hunting sparrows and larks. Men gave their lives to the study and training of falcons, and in many families generation succeeded generation in the practice of this art, father handing down to son his store of experience, and with it often his well-earned place of honor at the castle or the court. At one time we are told, "In the court of the King of Wales there were only three officers of his household above the master of the hawks. This person occupied the fourth place from the sovereign at the royal table, but he was prohibited from drinking more than three times, lest he should become intoxicated, and, in consequence, neglect his birds. Not only had he the management of the hawks and of the people employed in this sport, but, when he had been very successful in it, the king was accustomed to rise up and receive him on his entrance; and even, on some occasions, to hold his stirrup. Ethelston made North Wales provide him not only with so many dogs as he chose, 'whose scent-pursuing noses might explore the haunts and coverts of the deer,' but 'birds who knew how to hunt others along the sky.' In France there was an officer called the 'Grand Falconer,' who was a person of so much importance that his salary was four thousand florins, and he was attended by fifty gentlemen and fifty assistant falconers. He was allowed to keep three hundred hawks; he licensed every vender of hawks in the kingdom, and received a fee on every one of these birds that was sold. The king never rode out on any occasion of consequence without being attended by this officer."

Soon laws became necessary for the regulation and protection of the sport. In the reign of Henry VII, the taking of the eggs of hawk or falcon was punishable with imprisonment for 'a year and a day,' and a fine at the king's pleasure; and this, too,

even if the eggs were on the offender's own land. The use of the gyrfalcon was restricted to king or queen; an earl might own and fly the peregrine; a yeoman the goshawk; a priest was allowed the sparrow-hawk, while a servant might get what amusement he could from the kestrel.

During the sixteenth or seventeenth century falconry reached the zenith of its popularity in Europe, and before the beginning of the present century it had fallen into pretty general disuse. It is still kept up, however, on many a large estate in England and on the Continent, and in many cities of India and China at the present time, one frequently meets in the streets men carrying hawks on their wrists as their ancestors did a thousand years ago. In fact there are very few countries of the Old World where it is not still more or less in vogue, as well as in some parts of South America, though we are not aware that it has been practised in the United States.

The terminology of falconry is quite voluminous, hundreds of terms being used which are peculiar to the art, while many familiar words are used only in a peculiar or limited sense, so that a work on the subject would be hardly intelligible to the average reader without a glossary. We need not here trouble ourselves about many of these terms, introducing as few as possible, and explaining those which seem to need it.

There is little doubt, considering the high grade of intelligence of most birds of prey, that any of the forms which commonly catch living birds or quadrupeds might, with proper care and training, be made serviceable for hawking; but those which the experience of ages seems to have shown conclusively to be the best are the true Falconinæ (especially the members of the genus *Falco*) and the Accipitrinæ. These are very different in their structure and action, as already pointed out, and are therefore most often used on different classes of game. By the term game we must here be understood to mean the quarry, whatever it may be, whether eatable or not; for, as the main thing sought for in this pastime is sport, it is often better and more conveniently obtained from large and high-flying birds like herons, than from such birds as quails and partridges, which are more easily procured for the table in other ways.

In all ages and countries falconers have recognized these two classes of 'hawks;' the long-winged, dark-eyed falcons, which rise to a considerable height and 'stoop' on their prey at a single rush, being usually called 'noble,' while the short-winged, often yellow-eyed hawks, which fly low and chase after their prey, were styled 'ignoble.' The first, or 'noble' falcons, were most often taught to rise high above the hunter, and 'wait on' until game was found, while the second were oftener thrown from the hand on sighting game, and, unlike the falcons, were not often 'hooded.' The really good birds most readily obtained and easily managed were, in Europe, the goshawk and the peregrine, and these are the ones most often used now in England. The 'great northern' falcons, the various gyrfalcons, were more powerful, and could be used for some birds which the peregrine was no match for, but they were scarce and hard to obtain in the first place, did not thrive except in a cold climate, and were extremely difficult to tame and train. The different species of falcon vary much in their dispositions, and there are many other things to be taken into account in selecting a bird for service. The course of training is at best long and difficult, and while a week or two may suffice in some cases for young birds reared from the nest, others will require several months.

At the present time it is believed that as good results in the field may be obtained,

eventually, from young birds reared by the falconer (and then termed 'eyases'), as with full-grown, wild-caught birds, known as 'haggards'; but old-time falconers held the latter in much the higher estimation. The wild-caught birds are often much stronger, and hence better for large game, while their chief value lies in the fact that they have always been accustomed to hunt for themselves, and have thus acquired habits of watchfulness and daring which are difficult to cultivate in 'eyases.' They are, however, extremely hard to train at first, and very likely to forget their teaching and regain their liberty the first time they are 'flown' by the falconer.

In training a falcon, as in training a horse or a dog, one person should take entire charge of the bird, at least until well broken. The method ordinarily adopted is, briefly, as follows:—

At first the efforts should be principally toward rendering the bird quiet and tame in confinement. To this end she should be handled as much as possible, and stroked with a feather, using the voice frequently, and especially at feeding times. With a wild-caught falcon this will be slow work at first; the bird may refuse to eat for a day or two, and for some time her training will have to be conducted in almost total darkness. A leather 'hood' is placed over the head, and the bird must become accustomed to having this put on and taken off at all times, even while feeding, as well as to feeding with or without it, at first in the dark, and finally in broad daylight and in the presence of other persons. Then, step by step, she must grow accustomed to all sorts of noise and confusion, as well as learn to know the voice of her master, and come at his call. All this time a 'jess' (strap) will be kept on each leg, and when carried about she will perch on the glove or wristlet of her keeper. If more liberty be desired, a line may be fastened to the 'jesses,' and its length increased as desired. Up to this time she has only received food from the hand; now she must be made to go to it, and this is easily managed by letting her see it at a distance of a few feet, but refusing to give it her until she jumps or flies toward it. After she will thus go twenty or thirty yards without fail, the line may be taken off and the bird be taught to fly to her food from a much greater distance, — even half a mile at last. If the food so far used can be flesh of the game she is to be trained for, so much the better; and after she has caught a few pigeons, or other birds released from the hand, under favorable circumstances, she may be tried on wild game. It is important, however, that all her first trials shall be successful, and it is also well that, when first allowed to strike a bird at liberty, that bird shall be too large for her to carry off conveniently. After a little practice it will be found that the moment a falcon is unhooded in the open air and set free, she will immediately rise to a considerable height, and circle about, on the lookout for her accustomed food. This is called 'waiting on,' and if she has not been released until the dog has pointed, the game may now be flushed, and the falcon will be pretty certain to make a successful stoop and kill her bird, in which case she must be at once hooded, and either allowed to eat a little of the game killed, or else some other food must be substituted.

Should she fail to kill her game at the first plunge, and the bird take to the grass again, it must be flushed as quickly as possible, and a good falcon will 'wait on' again until offered another chance to strike. Young hawks, when taken from the nest before they can fly, must be suitably housed and fed until full grown, and no training except simple taming is at first attempted.

Usually they are left at liberty during the day, being accustomed to come at the call, or at regular feeding-times, and they must have food enough to prevent their

wandering off in search of it. As soon as they begin to chase other birds it is time their taming was begun, and they must now be caught and hooded, and taught in nearly the same manner as older birds; but this is much easier and more quickly accomplished. In order to make good hunters they must always be kept in good condition, fed just enough to keep them up to full strength, yet always with good appetites when brought to the field. Their food, also, when not hunting, should consist as largely as possible of game, and they must be allowed to eat naturally, swallowing bones, hair, and feathers, and ejecting from the mouth the 'castings' a few hours afterwards, in the same manner as wild hawks. In general, the more exercise they get the better.

As most falcons become much attached to particular breeding-places, it is easy for those who are conveniently situated to obtain the young in successive years from the same eyries.

Hawks were also always to be bought at reasonable prices before the beginning of the 'hawking season,' and thus in many cases owners were accustomed to set their birds at liberty at the close of the season, replacing them the next year with new ones, and thus avoiding the care of them through the greater part of the year. But gyrfalcons were too expensive to be thus released, and as they also retained their powers longer than others, and could be used for many years in succession, they were carefully kept for indefinite periods, occasionally doing good service for even fifteen or twenty years.

The taking of wild hawks, usually known as passage-hawks, from their abundance during the vernal and autumnal migrations, was usually effected by means of a net baited with a live bird, though frequently a decoy-falcon was used, being made to flutter as if killing game whenever a passage-hawk was seen in the distance. An owl was often the surest attraction for a hawk, the antipathy existing between the two seeming always to render it impossible for a hawk to pass over by daylight without one or two dashes at his nocturnal rival.

In training hawks the falconer had always to bear in mind not only the kinds of game which the bird was best fitted to take, but also the kinds which could conveniently be hunted in his immediate neighborhood. For the same individual was rarely trained, especially at first, for more than a single class of game: one for grouse, partridges, and, perhaps, pheasants; another for hares or rabbits; and others, still, for herons and waterfowl. Thus, to insure a good day's sport in the field, it was often necessary to be provided with a dozen or more of hawks, from which to select according to the game which presented itself. In its native state a hungry falcon would attack almost any bird which presented itself, and such, when captured and trained, would necessarily have to be flown with care at difficult game, and it was not uncommon, though of course very annoying, to have a falcon forsake the pursuit of a fine heron which was mounting skyward, and dart off after some luckless magpie or crow which chanced to cross his path. And this was the more vexatious because one of these 'small fry' would frequently evade the falcon by diving into thick shrubbery, whence the 'noble' hawk, baffled and angry himself, was not easily recalled by his master.

The heron was always a favorite with falconers on account of the good exhibition which the flight afforded. The best place for this kind of sport was on open, treeless ground, over which the herons were accustomed to fly at a considerable height in passing between their feeding-grounds and their nests or roosting-places. When attacked by a falcon under such circumstances, the heron seeks safety by rising high in the air, and so long as she can keep above her pursuer she has nothing to fear.

Both birds ascend in spirals; but the heron, with her light body and broad, concave wings, can rise in smaller rings than the falcon. The latter therefore describes a much wider circle, and, traveling with tremendous speed, and using her powerful wings at every turn, gains rapidly upon her quarry. Thus the struggle is steadily carrying both birds higher and higher, while the spectators, in order to keep the race in sight and be 'in at the death,' must gallop 'down-wind' across country, until they see that the falcon has at last 'got the sky' of her victim, and is about to 'stoop.' All eyes watch eagerly now, and the height is often so great that the two birds seem hardly larger than a couple of unequal-sized bees. For an instant the upper one seems to hang suspended and motionless, then shoots with incredible swiftness and unerring aim on the doomed heron. The blow may be evaded at first, but this is rarely possible more than a few times, for the long struggle for position has left little strength for any new effort, and so the falcon strikes fair on her back, either killing instantly by the mere shock of collision, as is usually the case with a smaller bird, or more slowly, but with equal certainty, by the driving home of the long curved talons, while both birds come whirling toward the earth, the falcon above, and striving with outspread wings to break the force of the fall. The falconer now runs forward and slips the hood over the falcon's head, after which she is fed, usually with game freshly killed for the purpose, which she is often allowed to eat while perched on the body of the heron.

Such a chase, while occupying but a few moments, is full of the most intense interest, and we can hardly wonder at the zeal with which such sport has been followed in days past. There is much difference in falcons, even of the same species, as to their power of killing, some being very strong 'footers,' while others, with equal power of wing, are unable to strike surely with the feet, and hence there may be a rough-and-tumble fight on the ground, in which the long bill of the heron is an ugly and effective weapon. The goshawk especially is slow in killing a large bird, and hence should never be flown at herons.

The full speed of the peregrine has been estimated at not less than one hundred and fifty miles an hour, and the gyrfalcon is believed to much exceed this. Even the goshawk, a much slower bird, easily overtakes the passenger pigeon in full flight, so that it is doubtless no uncommon thing for a falcon to take a dash of ten or a dozen miles in as many minutes, in the pursuit of a single victim.

The European woodcock is another bird which rises to a great height to escape the falcon, and, unequal as the race would seem to be, the woodcock is by no means always the loser, and not unfrequently both birds rise completely out of sight before the finish. Game which will thus 'take the air' in order to escape affords much better sport than any other kind, for the hawking of rabbits, or even hares, is tame sport, only visible to few, and often with much exertion in riding over rough ground and through thick woods; and while ducks and other waterfowl are often hunted with fair success by the peregrine, or even the goshawk, yet it can only be done under favorable conditions, as these birds usually escape by diving, if there be water enough at hand.

Probably the most difficult game ever successfully attempted was the kite, to the capture of which very few even of the strongest and best-trained falcons were equal; so that practically this sport was limited to the favored few who could afford to possess the swiftest birds. Thus, hunted mainly by royalty, the kite became known as royal game, and doubtless *Milvus regalis* gets its specific designation from this source.

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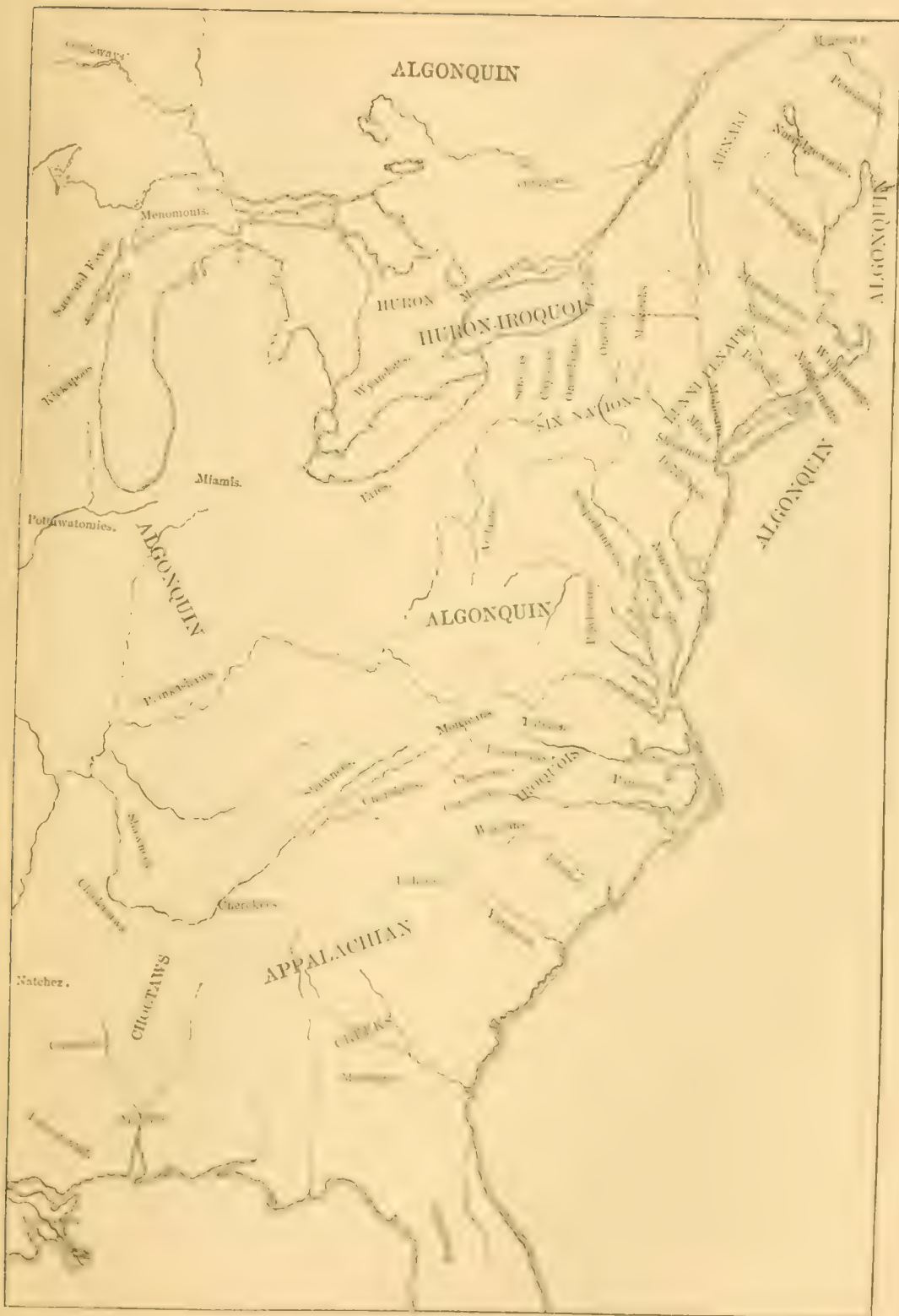
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1. *Nyticorax nycticorax*, night-heron ; 2. *Ardea cinerea*, common heron ; 3. *Ardetta minuta*, little bittern ; *Herodias alba*, egret.

Newton quotes an incident of this sport which occurred in the reign of the "British-Solomon," King James, according to which it seems that the French king's falconer, when sent to England to show his skill, "could not kill one kite, ours being more magnanimous than the French kite." Whereupon James's master-falconer, Sir Thomas Monson, at an expense of a thousand pounds, obtained a cast (couple) of hawks that took nine kites in succession. But the historian goes on to say that when King James himself was persuaded by this success to witness a flight in person, "the Kite went to such a mountee as all the field lost sight of Kite and Hawke and all, and neither Kite nor Hawke were either seen or heard of to this present."

Owls, generally speaking (the family STRIGIDÆ), are the nocturnal Accipitres. With all the raptorial nature of the diurnal birds of prey, they are yet very different in many details of structure, a few of which have already been mentioned. The head is relatively large and broad, and the eyes especially are very large, — larger than in any other family of birds except possibly the goatsuckers, or nightjars (Caprimulgidæ). The feathers surrounding each eye are generally of peculiar shape and texture, often more or less bristly, and tend to form a more or less shallow funnel, or hollow cone, at the bottom or apex of which the eye is situated. The eyes look almost directly forward, and thus, with their setting of radiating feathers — the facial discs — have a goggle-like appearance, which, though often unintentionally and grossly caricatured, is yet striking and often ludicrous. These circles of feathers about the eyes are evidently adaptations to the nocturnal habits of the birds, and are best developed in those species which are most strictly nocturnal, while in the few species which hunt much by daylight they are quite incomplete.

The eyes themselves are not less remarkable. In addition to their great size, they are of peculiar shape, being less nearly spherical than in other birds, and with the anterior portion much produced and cylindrical. They are also but very slightly movable, the bony plates which are found in the sclerotic coat of the eye in all birds being here most remarkably developed, and so closely fitted to each other and to the orbits that there is no perceptible rolling of the eye-ball, as in other birds, the whole head having to be turned instead. The iris is unusually broad, and capable of a surprising degree of expansion and contraction, while the pupil, instead of being circular, as in most birds, is, when moderately contracted, a perpendicular oval.

In many species, also, we find eyelashes, a rare thing among birds, though seen in ostriches and some others. In closing the eyes, moreover, the upper lid is principally effective, the reverse of what is true in most birds. The nictitating membrane, or third eyelid, is not, perhaps, better developed than in other Raptores; but the large size of the eye, and the fact that owls ordinarily sit during the daytime with this screen drawn over it (in the manner of a sickly chicken), make it unusually noticeable. There is usually a well-developed superciliary shield.

The ear also is remarkably developed, the orifice being often of peculiar shape, frequently closable by a movable flap or operculum, and ordinarily surrounded by one or more circles of feathers, which probably perform to a great extent the function of the external fleshy ear among mammals. The openings of these ears are often unlike on the two sides of the head, in at least one genus (*Asio*), the orifice on one side opening downward, and on the other upward. The bill is not remarkable in any respect, being usually short and frequently almost hidden by the bristly feathers about it, being, as it were, squeezed in between the discs which surround the eyes. It is always sharp and strongly hooked, but never notched.

The nostrils are of moderate or large size, and open in or near the anterior margin of the cere, being usually hidden by the bristles.

The legs are much longer than they appear to be, yet never very long. They are always feathered to or below the tibio-tarsal joint, and a really naked tarsus, *i. e.* without feathers or bristles, is rarely seen, while even the toes are often well feathered. The fact that the outer toe is reversible has already been noted, and although the presence of a similar structure in the osprey (*Pandion*) is probably to be regarded more as a coincidence than as evidence of true affinity, yet it is interesting to notice that the claws are very similar in the two cases. It will be remembered that in the osprey the talons are rounded, not grooved, beneath, and that they are of equal length on all the toes; while in most if not all other Falconidae the hind claw is usually largest, nearly equalled by the inner, and the middle and outer are respectively smaller and smallest. The owls most nearly resemble the osprey in these respects, for, although the claws are not smooth and rounded beneath, neither are they furrowed, but ridged; and very often all are of precisely the same size. Even when unequal, the middle claw is usually largest, being nearly equalled by the inner, while either the hind claw or the outer may be the smallest, though usually they are about equal.

The wings and tail are generally ample and rounded, the former always more or less concave, the latter often, but not always, short. The plumage is very soft, loose, and fluffy, giving a very false impression of size. Almost all the feathers are soft-fringed, and this is noticeable in the large flight feathers, especially on the outer webs of the primaries, where the fringe is stiffer than elsewhere, and the filaments more or less recurved, all combining to make the flight noiseless as possible. All the feathers are destitute of aftershafts, and the oil-gland lacks the usual circlet of plumes. A great many species show tufts of lengthened feathers on the head, one over each eye, usually called 'horns' or 'ears' though a better word is that suggested by Dr. Coues, who calls them plumicorns or feather-horns. It is almost needless to say that they have nothing whatever to do with the ears, and, as they are not peculiar to either sex, they probably serve no purpose as ornaments. They may be depressed or erected at the pleasure of the bird, but in many species are so large as always to be quite conspicuous. They increase the somewhat striking resemblance which the face of an owl bears to that of a cat, but what useful purpose they serve, if any, is apparently unknown. They occur in widely different genera, and differ much in size and form, but seem to be of little value, except in artificial classifications, representing perhaps the occipital crests so frequently met with among Falconidae, but entirely wanting among owls.

We have spoken of owls as the nocturnal birds of prey, and so most of them are; yet there is much difference among them as to the power of sight in the night-time, and the corresponding partial blindness by daylight. Not a few of them are entirely helpless in open sun-light, and if discovered under such circumstances may be easily caught in the hand. Others see perfectly well in the light, and even prefer to hunt by day in cloudy or foggy weather.

This is especially true of such species as the snowy-owl and hawk-owl, which inhabit the far north, where the summer is one long day, or at best there are but one or two hours of twilight in the course of the twenty-four. Probably the great majority of species prefer the twilight of morning and evening, or the semi-darkness of more or less moonlight nights. The structure of their eyes renders them very near sighted, and it seems very probable that many of them are able to hear a mouse much farther than they could see him, though there is a wide difference in this respect in different species.

Most owls are arboreal in their habits, but with quite a fondness for rocks and bushy cliffs, while very few are really terrestrial. In those which are most so, however, the claws are liable to be less curved.

The food is quite variable, but owls destroy immense numbers of rats, mice, and other 'vermin,' and are thus of incalculable service to man. Their habit (in common with other Accipitres) of ejecting by the mouth the indigestible parts of their food, renders the absolute determination of the character of their food comparatively easy. This subject has been very thoroughly investigated of late years in Europe, and the results show conclusively that while owls may occasionally do more or less damage in the destruction of useful birds, this is more than compensated for by the wholesale destruction of injurious rodents (especially Muridæ and Arvicolidæ) of which the bulk of their food consists.

Some forms feed largely on fish, which they catch for themselves, and it has been frequently noticed that in such species the legs and feet are usually bare; but, as Professor Newton remarks, we must not be too hasty in drawing conclusions from these facts, for the tarsi are also bare in some species which are not known to catch fish at all, and, we may add, many species which sometimes fish for themselves have both tarsus and toes well feathered. Indeed, the snowy-owl, with its feet so muffled in feathers as even to hide the claws, was seen by Audubon catching fish very skilfully from the 'pot-holes,' at the falls of the Ohio at Louisville.

Most owls follow the rule which obtains among other Accipitres as to relative size of the sexes, the female being usually the larger, but there are some exceptions. The sexes, however, are invariably alike in coloring, and the young do not seem to pass through any well-marked 'stages' of plumage after they once put off the down.

Melanism and albinism are both rare in this family, but in a large number of species belonging to several widely different genera, two phases of plumage occur independently of age or sex; one the 'gray' plumage and the other the 'red,' the prevailing color in the former being brownish gray, and in the latter rusty red. These phases were for a long time a puzzle to naturalists, it being at first supposed that the two colors marked different species; later, that they indicated either different sexes or ages; while it is now pretty generally conceded that both colors may be found in young from the same nest, offspring of the same parents, whether these be both red or both gray, or one of each. Moreover, it would seem probable that either phase once assumed is worn through life. Species in which both phases occur are often called dimorphic or dichromatic. Further reference to this subject may be found in the introduction to this volume (page 8).

The nesting habits vary much, but the eggs are normally always white, either pure, or yellow- or blue-tinted, and almost spherical. They are commonly more numerous than in other Accipitres, being usually four to six; but in several cases as many as eight or ten are laid; while in at least one species, and probably in more, the normal number appears to be two.

From the nocturnal preferences of most owls their habits are very slightly known, and many interesting facts are doubtless to be discovered in this direction. More often heard than seen, even their notes are only imperfectly known as yet, but are ordinarily monotonous and mournful, occasionally pleasing and almost musical, while the voices of some species appear never to have been heard. As to the manner of flight and method of hunting in nocturnal forms we know very little, and our inferences from structure must be of the most general kind.

The question of the division of the owls into sub-families is one which has long perplexed ornithologists. The group has seemed so homogeneous that good characters on which to found subdivisions were hard to find, and even now it would be premature to say that any unquestionable arrangement has been effected. Over forty years ago Nitsch showed that the feathering (pterylography) of the barn-owl or screech-owl, *Aluco flammeus*, was very different from that of all other members of the family, and some peculiar osteological characters were also found to exist in the same bird. On these discoveries as a basis, two sub-families were formed, and a few years ago there was a general feeling among systematists that at last the question was nearly settled, and they might safely place the barn-owls and their allies—less than half a dozen species in all—in one group; and all the remaining hundred species or more in a second. One species, however, *Phodilus badius*, which had been placed in the smaller group, has now been found by Alphonse Milne-Edwards to combine the peculiarities of both groups, and thus to be a true connecting-link between them.

It seems impossible to include *Phodilus* in either group, yet systematists are reluctant to allow it to stand by itself as the type of a new sub-family, and equally reluctant to unite all owls into a single group, only subdividing them into genera and species. Under these circumstances, and especially while new species are still being discovered, most ornithologists are inclined to wait for a time, and not commit themselves. The two main groups alluded to may be thus characterized:—

Sub-family Aluconinæ. Barn-owls and their allies. Sternum without manubrium and entire (*i. e.*, un-notched) behind; clavicles united together, forming a furcula, and solidly joined to the keel of the sternum; tarsus without a bony ring or arch over the extensor tendon of the toes; claw of the middle toe with its inner margin serrate.

Sub-family Striginæ. Other owls (except *Phodilus*). Sternum with a distinct manubrium, and with two or more clefts or notches in the hinder margin; clavicles never united to the keel of the sternum, often not even united to each other; tarsus with a bony ring or arch over the groove, in which lies the common extensor tendon of the toes; inner margin of middle claw not serrate.

Phodilus, or *Photodilus* as it is also written, agrees with the Aluconinæ in wanting the manubrial process of the sternum as well as the bony arch on the tarsus, but differs from them and agrees with the Striginæ in having the hinder margin of the sternum distinctly notched, while the clavicles are neither united to each other, nor to the keel of the sternum.

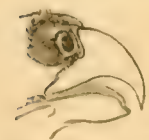


FIG. 170. Bill of *Speotyto*, showing nostril.

The burrowing-owl, *Speotyto cunicularia*, is one of the most peculiar forms which we meet with among the owls, and, although too well known to warrant extended description, we can hardly pass it without calling attention to its long slender legs, imperfect facial disk, and terrestrial habits. It is about nine and a half inches long, the tail however, being rather short,—only three to three and a half inches. The colors are brown and yellowish-white in about equal proportion, the upper parts being brown with very numerous roundish white spots, while the under parts, wings, and tail are barred with brown and white. The sexes are alike in size and color. It is peculiar to America, where it occurs abundantly in some places, especially on the pampas and adjacent lands of South America, and the plains of the western United States. On the west coast of North America it extends northward to the Columbia River, while on the east coast a few isolated colonies are found in Florida, and it occurs abundantly in Texas. On the island of Guadeloupe, in the West Indies, a form is found which has sometimes

been ranked as a distinct species, *S. guadeloupensis*, but this seems to be only a variety of the South American bird.

Burrowing-owls are notorious from their association with the prairie-dog and other mammals in whose deserted burrows they commonly live, though their relations with the earlier occupants and the intruding rattle-snakes, contrary to popular belief, are usually anything but peaceful. The mistake has doubtless originated from the observed fact that in the so-called 'villages' of the prairie-dog, owls and snakes as well as 'dogs' are often abundant, and all living in burrows *originally* made by the rodents. Yet there is no reason to believe that they ever all live in the same underground chamber, or that either bird or reptile lays aside its usual instincts and abstains from an occasional meal off each other or the young prairie-dogs. On this subject, Dr. Coues, in his "Birds of the Northwest," remarks:—

"The case is further complicated by the introduction of the rattle-snakes; and no little pure bosh is in type respecting the harmonious and confidential relations imagined to subsist between the trio, which, like the 'happy family' of Barnum, lead Utopian existences. According to the dense bathos of such nursery tales, in this underground elysium the snakes give their rattles to the puppies to play with, the old dogs cuddle the owlets, and farm out their own litters to the grave and careful birds; when an owl and a dog come home, paw-in-wing, they are often mistaken by their respective progeny, the little dogs nosing the owls in search of the maternal font, and the old dogs left to wonder why the baby owls will not nurse. It is a pity to spoil a good story for the sake of a few facts, but, as the case stands, it would be well for the Society for the Prevention of Cruelty to Animals to take it up.

"First, as to the reptiles, it may be observed that they are like other rattle-snakes,—dangerous, venomous creatures; they have no business in the burrows, and are after no good when they do enter. They wriggle into the holes, partly because there is no other place for them to crawl into on the bare, flat plain, and partly in search of owls' eggs, owlets, and puppies to eat. Next, the owls themselves are simply attracted to the villages of prairie-dogs as the most convenient places for shelter and nidification, where they find eligible ready-made burrows, and are spared the trouble of digging for themselves. Community of interest makes them gregarious to an extent unusual among rapacious birds; while the exigencies of life on the plains cast their lot with the rodents."

Wherever these owls are found, they make use of holes in the earth for breeding purposes. Not only do they use the holes above alluded to, but they frequently take possession of those of foxes, badgers, and ground squirrels; and in South America they live in the burrows of the viscacha, *Lagostomus trichodactylus*, the Patagonian 'hare' or cavy, *Dolichotis patagonicus*, or even of armadillos and large lizards. It is pretty generally believed that when they do not find suitable accommodations of this kind they dig holes for themselves, and this may indeed be the case, but we are not aware that anyone has ever seen them so employed. The burrowing-owls of North and South America, though unquestionably belonging to the same species, are sufficiently different to constitute two fairly well-marked geographical races, the South American bird being larger and lighter colored than the other. In habits they must differ still more widely, for the bird of the western United States is described as almost entirely diurnal, while the South American bird is as completely crepuscular or nocturnal; sitting, it may be, at the mouth of its burrow during the daytime, or on the top of a bush near at hand, but seldom feeding at all until towards sunset, when it becomes

very active. On the pampas it is usually very tame, permitting one to walk up quite close before taking flight for another bush or hillock; but after sunset it becomes very vigilant, flying up and hovering at a height of thirty or forty feet, and uttering its screams of protest whenever an intruder appears in sight, thus giving ample warning to its neighbors, the viscachas.

On the plains of the United States they seem to be more timid and wary, and are said to feed mostly in the daytime. Their food is usually stated to consist mostly of reptiles and insects, but they certainly consume large numbers of mice and some small birds. They neither migrate nor hibernate, but are abroad and active all winter. According to Mr. Agersborg, in south-eastern Dakota, in winter, as many as twenty of



FIG. 151. — *Athene noctua*, little owl, civetta.

these birds may be found living together in the same burrow, and in one such case he found forty-three mice and several shore-larks "scattered along the run to their common apartment."

The nest is simply a collection of grass, feathers, and rubbish placed at the end of the burrow, and contains from five to ten short elliptical, or nearly spherical, white, unspotted eggs. The nest, and often the entire burrow, is filthy beyond description, from the accumulation of remnants of food, the ejected pellets of the birds themselves, etc.

The nearest relatives of *Speotyto* would seem to be the members of the Old World genus, *Athene* (*Carine*), and one or more species from the West Indies, belonging to the genus *Gymnasio*. *G. lucenci*, found in Cuba, is rather smaller than the burrowing-owl, and with proportionally shorter legs, the tarsi and feet, moreover, being per-

feetly bare of feathers or bristles, and covered with small irregular-shaped plates, as in the tarsal covering of falcons.

The genus *Athene*, in which the burrowing-owl was formerly placed, as now framed includes but two species, one of which, the little owl of Europe, *Athene noctua*, is the bird which among the Greeks was sacred to Pallas Athene, and is so often represented with the Goddess of Wisdom on their coins and sculptures; "but," says Newton, "those who know the grotesque actions and ludicrous expression of this veritable buffoon of birds can never cease to wonder at its having been seriously selected as the symbol of learning, and can hardly divest themselves of the suspicion that the choice must have been made in the spirit of sarcasm." For many of the following notes on this species we are indebted to the excellent account of it given in Dresser's "Birds of Europe."

It is from eight to nine inches in length, or a trifle smaller than the common mottled-owl of the United States. Its color above is brown with white markings, — stripes on the head, spots on the back, wing-coverts, etc., and bars on the wings and tail.

Below, it is buffy white, with dark-brown stripes or longitudinal dashes. Through central and southern Europe it is a common and well-known owl, but rarely reaches England or Sweden, though found regularly in Denmark.

Its favorite haunts are in the neighborhood of towns, though it is frequently met with in the country, and in Holland is usually found in the orchards close to farm-houses. In such places it usually nests in the hollow of a tree, laying from three to five eggs without any sign of a nest, but ordinarily it prefers deserted buildings, church-towers, ruins, chinks of rocky walls, or the crevices of bushy cliffs. According to Mr. Keulemans, these little owls have a strong aversion to water. He has kept them in a cage for more than a year without giving them any, while "it is a curious fact than when they get wet, either by heavy rain or by being placed in a damp spot, they have fits and remain insensible for hours, and sometimes it causes their death." In Italy it is known as the 'civetta,' and Mr. Charles Waterton says of it: "This diminutive rover of the night is much prized by the gardeners of Italy for its uncommon ability in destroying insects, snails, slugs, reptiles, and mice. There is scarcely an out-house in the gardens and vineyards of that country which is not tenanted by the civetta.

"It is often brought up tame from the nest, and in the month of September is sold for a dollar to sportsmen, who take it with them in their excursions through the country to look for larks and other small birds. Perched on the top of a pole it attracts their notice, and draws them within the fatal range of gunshot by its most singular gestures; for, standing bolt upright, it curtsies incessantly, with its head somewhat inclined forwards, while it keeps its eyes fixed on the approaching object. This odd movement is peculiar to the civetta alone; by it the birds of the neighborhood are decoyed to their destruction; hence its value to the ranging sportsman.

"Often and anon, as the inhabitants of Rome pass through the bird-market at the Pantheon, they stop and look and laugh at this pretty little captive owl whilst it is performing its ridiculous gesticulations." Like many other owls which prefer the dusk for hunting, it is, nevertheless, often abroad in the daytime, especially when it has young to feed. It would seem to suffer less from the glare of the sun than from the persecutions of small birds which often follow it about in large numbers, harassing it continually from every side. In Germany, according to Naumann, it has a variety of

notes, some smothered, and dull others loud and clear. "These notes are often variously modulated by the bird itself or the action of the air, and are supposed by the superstitious peasants to form connected sentences, as, for instance, 'Komm-mit, komm-mit auf den Kirschoff-hof-hof (Come with me, come with me to the churchyard-yard-yard);' and the bird is looked on by them as a prophet foretelling death." Although this species destroys some small birds, it is in the main decidedly beneficial, feeding mainly on mice and other small rodents, and insects.

The single other species of this peculiar genus is the spotted-owl, *Athene brama*, which is a well-known and abundant bird in India, where it replaces the little owl.

In the extreme southwest of the United States, a tiny owl is found, which seems to be somewhat nearly related to the several species already mentioned, although perhaps equally near the pigmy-owls which follow. It is known as Whitney's owl, *Micrathene whitneyi*, and the first specimen was taken by Dr. J. G. Cooper at Fort Mojave in the valley of the Colorado in 1861. During the next dozen years only two or three more specimens came to light, and it is only within the last three or four years that it has been met with more abundantly, while it is still very rare in collections. It is undoubtedly the smallest known species of owl, and one of the very smallest of all birds of prey; the only ones which approach it at all being one or two species of the pigmy-owls (*Glaucidium*) and the finch-falcons (*Hierax*). The total length of large specimens seldom exceeds six inches, the average being probably about five and three-quarters inches. The tail measures between two and two and one-quarter inches, while the wings, which are proportionally longer than in most owls, average about four and one-quarter inches.

Like all the owls thus far mentioned, it has no 'plumicorns' (ear-tufts), the legs are bristly, being feathered but slightly below the heel joint, and the facial disk is imperfect. This last condition is in most owls found to accompany more or less diurnal habits, but the present species seems to be pretty strictly nocturnal. One of its most peculiar characteristics is seen in the claws, which, as Dr. Coues says, are "remarkably small, weak, and little curved; hardly more than insectorial instead of raptorial in character." Its coloration is not easily described, but in general it is light brown above, each feather with an angular dot of lighter color. There is an indistinct whitish collar about the neck, and a white stripe along each shoulder. The under parts are whitish, blotched and imperfectly barred with reddish-brown, and the wings and tail are brown, barred with whitish. The face is mostly white, and the iris bright yellow. The sexes seem to be exactly alike in size and color.

This interesting little owl, so far as now known, seems to be most abundant in Arizona, where several collectors have met with it, and two specimens have also been taken on Socorro Island, off the west coast of Mexico. Mr. F. Stephens recently found it fairly common in the region about Tucson, Arizona, where he found the females frequenting the giant cactuses, and breeding in holes of their stems, while the males were more often met with in elder and willow thickets. The first specimen was discovered by accident, in cutting down a cactus to examine a woodpecker's hole.

Mr. William Brewster has given an account of Mr. Stephens' collection, and publishes many field-notes on the birds observed. Among Mr. Stephens' notes is the following account of the present species. "I was walking past an elder-bush in a thicket, when a small bird started out. Thinking it had flown from its nest I stopped, and began examining the bush, when I discovered a Whitney's owl sitting on a branch with its side towards me, and one wing held up, shield-fashion, before its face. I

could just see its eyes over the wing, and had it kept them shut I might have overlooked it, as they first attracted my attention. It had drawn itself into the smallest possible compass, so that its head formed the widest part of its outline. I moved around a little, to get a better chance to shoot, as the brush was very thick, but, whichever way I went, the wing was always interposed, and when I retreated far enough for a fair shot I could not tell the bird from the surrounding bunches of leaves. At length, losing patience, I fired at random and it fell. Upon going to pick it up I was surprised to find another, which I had not seen before, but which must have been struck by a stray shot." Mr. Brewster adds: "Rather curiously both of these specimens proved to be adult males. It is by no means certain, however, that the males



FIG. 152. — *Nycatala tengmalmi*, tengmalm's owl, and *Glaucidium passerinum*, pigmy-owl.

are not to a certain extent gregarious during the breeding season, for on another occasion two more were killed from a flock of five which were sitting together in a thick bush."

The eggs were always laid in deserted woodpeckers' holes in the cactuses, but were rarely accessible without felling the trunks, which always resulted in breaking the eggs. A single whole one, however, was obtained from one nest which was within reach. It was pure white and measured 1.07 by .91 inches. "Fresh eggs were found from May 10 to June 27, dates which indicate that the species breeds rather late in season."

Not very much larger than Whitney's owl is the Californian pigmy-owl, *Glaucidium passerinum*, which we may take as a fair representative of the genus *Glaucidium*.

The members of this group resemble, in their small size, imperfect facial disk, and lack of plumicorns, the species just described, but are readily distinguishable by their very strong beak and strong, much curved claws, together with proportionally longer tail, much shorter wings, and densely feathered tarsus. Their whole structure is extremely compact and strong, indicating their ability to cope successfully with animals of their own size or larger; hence the statements that they feed mainly on insects, and are satisfied with a very few of these, need strong confirmation in order to appear even plausible, while the undeniable fact that they habitually hunt more or less during the day gives little ground for the surmise that they are inactive at night; much less, as some writers assert, that they go to roost at nightfall like the majority of birds. We suspect the truth to be that most of their serious hunting is done under cover of darkness, and that the observed insect-catching is only an amusement indulged in to while away the tedious hours of daylight.

The pigmy, or gnome-owls, as they are frequently called, commonly inhabit the deep woods, and their manner of life is very slightly known, notwithstanding their comparative abundance in many places. Twenty-five or thirty species have been described, and only ten years ago Mr. R. B. Sharpe admitted twenty-three or twenty-four species, twelve of which were American. There is now, however, little question that we have in America not more than five or six distinct species, one of which (*passerinum*), is the same as the European, while it is probable that the Old World species must suffer a like reduction. Thus each of the islands, Formosa, Java, Sumatra, and Ceylon, has been credited with its single peculiar species, while China and Japan have another, and India and Africa each two or three more. Just how many of these are local, climatic, or geographical races of the others, we are not prepared to say, but it is our conviction that there are certainly not more than a dozen valid species of *Glaucidium* known to science at the present time, and even that number may have to be considerably lessened as our knowledge of the group increases. They are mainly dwellers in the tropics, where they are found all round the world, but they appear to be entirely absent from Australia.

One species, the sparrow-owl, *G. passerinum*, is pretty generally distributed through Europe, and is represented in the western United States by a rather darker race formerly separated as a species, *G. californicum*, but not really distinct from the European bird. It ranges from Vancouver's Island southward to Mexico and Guatemala, where, however, it seems to be partially replaced by another species, *G. ferrugineum*. This latter, like several others among the pigmy-owls, shows the dichromatism already alluded to, some specimens being in gray plumage and others in red, independently of age, sex, or season. The European bird, however, and its American representative rarely show this red phase well, it being much more characteristic of the tropical members of the genus. Even among these it is not known to occur in every species, and often where a species shows red and gray forms of the most pronounced type, individuals are also found representing every conceivable intermediate stage, some examples combining the red and gray in such equal proportion that it is impossible to say which they most resemble. Independently of these phases there is considerable variation of color and markings among individuals of the same species, so that on the whole the pigmy-owls form a very perplexing group.

Most of the species, when young, have the upper surface of the head of uniform color, unmarked with either spots or streaks. Few adult birds preserve this character, and frequently the whole upper surface is spotted, streaked, or barred. The wings

and tail are almost always so, and variations in the number, color, and form of the tail-bars seem often to be of specific importance. The under parts, especially the sides of the breast and belly, are often heavily streaked with a darker color than that which is found elsewhere below, while between the chin and breast, which are light colored, there is almost invariably a darker zone or band, which may be simply an aggregation of spots or streaks, or a belt of uniform color. Equally constant is a narrow half-collar or are, of various tints in different species, which marks the division between the plumage of the hind-neck and the back. It may consist simply of a few white or reddish feathers, or it may form a very distinct, single, double, or even triple-striped band, but in any case contrasts strongly with the colors of neck and back which it separates.

In size the species vary considerably, the smaller, such as *passerinum* of Europe, or *pumilum* of South America, being probably not far from six inches in length, while the Himalayan *cuculoides* and the South African *capense*, which are among the largest, have a length of about eleven inches. The sexes vary somewhat in size, the female, of course, being the larger, and in some species there seem to be slight differences in color between the sexes. There is also not a little difference among species in the degree of nakedness of the feet, for while most of them have the feet merely bristly and the tarsi well feathered, one or two have the toes fairly feathered; in others they are but scantily provided with bristles, and in some the feathers of the lower part of the tarsus are reduced almost to bristles.

The Cuban pigmy-owl, *G. siju*, is said to differ from all others in that the nostril opens at the edge of the cere instead of in its middle. Fair examples of the remaining species are the two found in North America — the Californian pigmy, *G. passerinum*, and the red-tailed pigmy, *G. ferrugineum*. The normal plumage of the former is chocolate or umber brown above, with numerous small, rounded spots of reddish white; below, pure white, with spots of brown and streaks of black, the wings with three, and the tail with seven or eight incomplete white bars. The red plumage is very similar, except that the umber brown is replaced everywhere, except on the tail, by a rusty brown of varying intensity. The red-tailed pigmy, in normal plumage, is very different. With much the same general color above, the markings on the head are narrow streaks of dirty white. There are no spots below, but the sides have long dashes of brown. The wings have five rufous bars and some whitish spots, while the tail varies from brownish-red to clear rufous, and is crossed with six or eight bars of dark brown. The red plumage, which is of frequent occurrence, is very marked, often almost hiding both the light markings of the upper parts and all the markings of wings and tail, the black cervical collar alone remaining conspicuous. This species was taken by Mr. Sennett in Texas, and by Captain Bendire in Arizona; but it is properly a more southern bird, ranging from Mexico to Peru and Bolivia. Of its habits little seems to be on record, but they probably do not differ much from those of allied species.

The Californian pigmy is perhaps better known; but the records of this bird's habits leave much to be desired. On Vancouver's Island Mr. J. K. Lord watched a pair which had a nest in the hollow of an oak. He considered them strictly insectivorous, but never saw them take insects on the wing. During the day they were more or less on the alert for insects, but were especially active in the twilight of morning and evening; yet Mr. Lord believed they did not hunt at all during the night. Two eggs only were laid by these birds early in May, but more recently (June, 1883), Captain Bendire found a nest at Fort Klamath, Oregon, which contained four young.

It was in the cavity of a live aspen, and the young birds were feeding on a freshly-killed chipmunk (*Tamias*).

A pigmy-owl, *G. nanum*, the *Caburé* of Azara, which inhabits southern South America, is believed by the natives of that country to attract snail birds about it by its bewitching song, after which it picks out and pounces upon one of the fattest of its admirers, which it proceeds to devour. This story, which we have ourselves repeatedly heard in the Province of Entre Rios, is easily accounted for, with the exception of the song, for nearly all owls are objects of curiosity to other birds, many a one of which pays dearly for his inquisitiveness. It does not become us, moreover, in the light of certain facts with regard to the musical ability of some hawks, and the imitative powers of at least one species of owl, to smile too incredulously at these tales; for, while we may have little or no faith in their trustworthiness, it is certainly not impossible that birds so slightly known as these owls may possess vocal powers not yet officially recognized.

From the larger pigmy-owls, especially those with bare feet and somewhat bristly legs, it is but a short step to the owls of the genus *Ninox*, which differ mainly in larger size, much longer and pointed wings, and in having the lower part of the tarsus mostly hairy instead of covered with feathers. The bristles of the feet are so noticeable in most of the species that they are often called the hairy-footed owls. Were it not for the long and sharp-pointed wings it would be difficult to separate this genus from the preceding, to which it is certainly very nearly related. The wings, however, in *Ninox*, when folded naturally, reach considerably *beyond* the middle of the tail; while in *Glaucidium* they rarely reach even to the middle, usually falling far short of it. In size the species vary from that of a rather large pigmy-owl, say eight or nine inches long, up to more than two feet in length, a size only attained, however, by the powerful-owl, *Ninox strenua*, of New Zealand.

The genus seems to be nearly confined to the Indo-Malayan and Australian regions, ranging from Japan to New Zealand, and reaching Ceylon and the Himmalehs on the west. A single species also, *N. superciliaris*, is credited to Madagascar. It is almost impossible at present to do more than guess at the actual number of species included in the genus. As many (twenty-five or thirty) have been described as in the preceding genus, perhaps with no better grounds, and species-makers are still publishing new ones on the strength of single, and oftentimes young or imperfect, specimens. Much of the territory lying within the range of the genus is also as yet unexplored, and may reasonably be expected to yield one or two new forms, as well as some new light on the relationship of the various doubtful members of the group.

One widely-ranging species, *N. scutulata*, is found throughout the whole extent of the Indo-Malayan region, but is absent from Australia, while a second and closely allied species inhabits the Himmalehs; Australia has several large species; New Guinea is credited with as many more, while nearly every good-sized island among the East Indies claims at least one peculiar species. Some of these seem to be well marked, while others are unquestionably only local forms of well-known species, or even mere individual varieties.

Many beautiful birds are found among the species of *Ninox*, the colors being usually soft grays and browns, with black or white touches here and there, and the wings and tail often barred with light and dark. Russet-browns, and even brighter rusty tints, are so common that one cannot help suspecting that dichromatism is common here as well as among the pigmy-owls, though it has not yet been recognized

so far as we are aware. The hairy-footed owls are more graceful in shape than most of those we have thus far considered; the long tail and wings, together with the smooth, tuftless head, and less-staring eyes than usual, combining to give a neat and attractive appearance. Though not so notoriously diurnal as some others, the most of them see well by daylight, and seem perfectly able to take care of themselves if disturbed in the middle of the day. A specimen of *N. scutulata* (*hirsuta*), taken in southern Ceylon by Lieutenant Legge, had its stomach crammed with undigested beetles, although it was shot about two o'clock in the afternoon, showing that it must have been feeding late in the morning; and, indeed, the same collector observed that this species regularly 'hooted' before sunset and long after sunrise, as well as through the night. Mr. Swinhoe found the northern race (*japonica*) of this same species to be migratory at Chefoo, north China, passing northward in May and returning in October.

The powerful-owl, *Ninox strenua*, of Australia, is said to be chiefly nocturnal in its habits. According to Gray, it is an inhabitant only of the 'brushes,' particularly those along the coast from Port Philip to Moreton Bay, and has a note "hoarse, loud, and mournful, resembling the bleating of an ox." As already stated, it is the largest member of the genus, and also the largest owl of Australia, and only equalled in size among the diurnal birds of prey in that country by the wedge-tailed eagle, *Aquila audax*, and the white-bellied fishing-eagle, *Ichthyophaga leucogaster*. Only slightly inferior in size is the winking-owl, *N. connivens*, also of Australia, a well-known inhabitant of the wooded districts, where it hunts by day, and is said to be one of the most merciless enemies of the koala, or Australian bear, *Phascogaleus cinereus*, the young of which it often carries off bodily.

A much smaller bird is the New Zealand owl, *N. nova-zeelandiae*, in which, according to W. L. Buller, the female is *smaller* than the male, a statement which, if substantiated, will record a fact unique, so far as we know, among birds of prey.

Apparently belonging to the same section as the foregoing five genera, is the rare and little-known laughing-owl, or white-faced owl, *Sceloglaux albifacies*, of New Zealand. Although formerly somewhat more abundant than at present, it is not known ever to have been plentiful, and is now believed to be rapidly becoming extinct. Dr. Buller, long resident in New Zealand, writing in 1874, says of it: "As to the present scarcity of the bird, it may be sufficient to state that I have never heard of more than a dozen specimens, and have never seen but one living example." It agrees in several points, such as the tumid cere and long legs, with the genera already treated; but its skeleton is remarkable for the great size and strength of the clavicles, as well as for other peculiarities. Owing largely to its rarity, as well as partly to ignorance of the interest attaching to its structure and life history, it seems never to have been made the subject of special investigation, and so is in a fair way to become extinct before its true relations to other species or groups have been fully settled. It is a rather large owl (about a foot and a half long), with about the same proportions as the barn-owl (*Aluco*), except that the wings are shorter. Its specific name, *albifacies*, refers to the whitish color of the face and sides of head; but these parts are all more or less streaked with brown and black, so that this name is not particularly appropriate. The name, laughing-owl, is intended to be suggestive of the odd vocal gymnastics of the bird.

Thus far we have been dealing with owls which show a swollen cere, and nostrils opening fairly within it, while the long legs commonly have a tendency to be bare or bristly. The remaining owls of this sub-family, though varying much in other respects,

agree in having the uninflated cere more nearly as in the diurnal birds of prey, but with the nostrils usually situated on the line between the cere and the bill, rarely entirely in the cere, never entirely outside it. The legs, too, in a majority of the species, are pretty well feathered, though the feet may be either perfectly bare, bristly, or densely feathered. This last condition is exhibited in the highest perfection by the hawk-owl and the snowy owl, species which are common to the Old and New Worlds, and inhabit the extreme north of both continents.

Surnia funerea, the hawk-owl, so called in reference to its hawk-like appearance and diurnal habits, is a circumpolar species, only found in the temperate zone in winter. Fitted to withstand the severest cold, its southward movement even then most probably depends on variation in its food supply rather than on temperature. Its home is in the northernmost regions of America and Asia, and it is rarely seen in the United States except in winter, though it is said to breed in some parts of Maine. It has been taken as far south as New Jersey and Ohio, but ordinarily does not pass south of Massachusetts. An abundant bird of Alaska, yet south of British America it has not been met with west of the Rocky Mountains; and at any season of the year must be considered an extremely rare bird within the limits of the United States.

Yet on rare occasions it appears along our northern border in considerable numbers, as was the case in October and November, 1884, when a "wave" of them inundated northern New England to an extent without a parallel in the history of the species. Hundreds of them were killed in the course of a few weeks, and they suddenly became as common as 'chicken-hawks' in places where they had never before been seen. Unlike most other owls, this species lies so much in the daytime that it is not readily overlooked, and the fact that in summer it has not been noted in New Brunswick, or even in most parts of Canada, shows that it is a decidedly northern bird. In summer it is said to feed almost entirely on field-mice (*Arvicole*) and insects, and in winter on such birds and small mammals as can be found. It is usually seen perched on the top of some small tree, whence it makes forays for any game which shows itself. It seems to be entirely unmindful of sunlight, and probably does most of its hunting during the day, though known to be active at twilight. Swift and strong on the wing, it is unusually courageous, often even attacking a man in defence of its nest. It is known to nest in hollow trees, and Mr. Dall found the eggs in Alaska placed in the hollowed top of a birch stub some fifteen feet from the ground; yet it is said by Richardson, McFarlane, and others, to build a somewhat bulky nest of sticks, grass, and moss in large trees. The eggs vary in number from four to seven. The heavily feathered toes have already been mentioned, and so completely muffled are they that they are frequently spoken of as 'paws.' The general plumage of the hawk-owl is quite different from that of most owls, being much more compact and firm, the feathers lacking in large measure the softness and fringed edgings so characteristic of owls' plumage in general. The form, too, is slender and trim, the wings and tail quite long, the facial disc quite imperfect, and the general appearance, at rest or in action, decidedly hawk-like. The colors are umber-brown, black, and white, the face and throat being entirely whitish, often bordered below and at sides by a varying amount of black. The upper parts are variously spotted with white on a brown ground, and the under parts closely barred from upper breast to tail with reddish brown bars on a white ground.

The hawk-owl of northern Asia and continental Europe is lighter colored than the American bird, and is usually separated as a geographical race (*ulula*). Dr. Brewer,

however, has recorded the capture of both forms at Houlton, Maine, while according to Dresser the Asiatic form does not occur in Great Britain at all, but whenever a hawk-owl has (rarely) been taken there, it has proved to be in the plumage of the American bird.

The snowy-owl, *Nyctea scandiaca*, is a much better known bird than the preceding, owing, doubtless, in part to its large size and snowy plumage, but also to the fact that



FIG. 153. — *Nyctea scandiaca*, snowy-owl, and *Syrnium lapponicum*, great gray-owl.

it has a much wider range, being not uncommon in all the northern United States in winter, and having occurred even in Kansas and Texas. Occasionally it becomes abundant in the United States in winter, several invasions similar to the 'wave' of hawk-owls mentioned above being on record. Apparently the latest of these took place during the winters of 1861-62 and 1876-77. Of this last inroad, Mr. Ruthven Deane has given an account from which we extract the following:—

"About the first of November, 1876, large numbers suddenly appeared along our coast. This being the season when sportsmen and the market gunners were in pursuit

of water-fowl on the sea-shore, dozens of snowy-owls were shot by them, and sent to the markets and to the taxidermists, so that during the three following weeks it was a common thing to see them hanging with other game in the markets, or confined alive. I first heard of them on our Massachusetts coast as frequenting the islands off Rockport, where numbers were taken.

"One gunner spoke of seeing fifteen at once on a small island one foggy morning, nearly half of which he procured. Several were shot in the very heart of the city of Boston, where they were occasionally seen perched upon the house-tops or church spires. The migration seems also to have extended far to the southward of New England, as I learn from Mr. Boardman that specimens have been taken as far south as Philadelphia, Baltimore, and Washington. In Philadelphia Mr. John Krider, the well-known taxidermist, had forty sent to him for preparation during October and November. One was taken near Baltimore during the last of September. I have heard of some five hundred specimens that have been seen, the majority of which have been shot."

They are found all over northern Europe and Asia, and are occasionally taken in Great Britain, and there seem to be no constant differences of any kind between Old and New World specimens, unless Mr. Sharpe's observation, that in European birds the toes are much more heavily feathered, should prove always to hold true. The general color of the snowy-owl is pure white, usually more or less distinctly barred with brown, and it is doubtful if these brown markings are ever entirely lacking on the hind neck, while birds which with this exception are entirely white are extremely rare, and are usually very old males. Young birds, even when fully feathered, often show as much brown as white, and it has been noticed that the specimens which range southward in winter are almost always these much-spotted individuals, fairly white birds being always comparatively rare.

This owl and the gyrfalcon are probably the only birds of prey which remain in the Arctic regions through the winter, but it seems to be unaffected by the cold, and has been met with as far toward the pole as man has yet reached. It is interesting to notice that no seasonal change in plumage, like that which the ptarmigan undergoes, has been observed in this species, which, when adult, needs no protective coloration, and so retains its white dress through the summer. The nestlings, however, are at first of a uniform sooty-brown, which must be a considerable protection to them during their long stay in the nest, in its exposed position on the ground. This bird is known to breed in Labrador, said to do so in Newfoundland, and *suspected* of it even as far south as Maine, but its true breeding range probably does not extend south of the parallel of 50°, while it breeds most abundantly very much farther north. The nest is seldom more than a hollow in the moss, or a slight depression in a ledge, with perhaps a few feathers added. In this simple affair from six to ten eggs are laid, usually at intervals of at least several days, so that the first have hatched before the last are laid, and the young birds thus contribute their warmth to the other eggs, leaving the parents more at liberty to seek food for themselves and their young.

The same habit has been noticed among other owls, especially among those which breed early in the spring, when the weather is still very cold. The snowy-owl is almost as diurnal in its habits as the hawk-owl, hunting, however, both by night and day whenever circumstances favor or require it. Though usually quite shy and difficult of approach, it is said to be easily decoyed within range, when there is snow on the ground, by tying a mouse, a bit of hare's skin, or even a bunch of dark rags, to a

long cord, and letting this drag behind as the hunter walks. Its fondness for fish has been frequently noticed, and this partly explains why, during its winter visits to the United States, it is more abundant on the seaboard than in the interior.

Many other owls are fond of fish and are skilful in catching them, but only two genera seem to have the feet specially modified for this purpose, viz., the African genus *Scotopelia*, and the Asiatic *Ketupa*. In both these forms the under surface of the toes is thickly beset with papillæ or spicules, as in the osprey, and the large, strongly curved talons are of nearly equal length on all the toes. In *Scotopelia* the head is smooth, and the tarsus is entirely bare behind, and only feathered in front for a little distance below the tibio-tarsal joint; while in *Ketupa* rather less than the lower third of the tarsus is bare, and the head has prominent plumicorns two or three inches in length. Three species of each genus have been described, but the characters on which they are founded would seem, from the descriptions, to be very slight. All are very large owls, and are supposed to feed largely, if not entirely, on fish and crabs, but, as they are inhabitants of the deep forests and appear to be nocturnal in habits, they have seldom been seen fishing. Mr. Swinhoe, while at Ningpo, China, dissected a specimen of *Ketupa flavipes* which had the stomach "crammed with bones and other remains of fishes, the largest about four inches long." *Scotopelia peli* is found in western and southeastern Africa, and *Ketupa ceylonensis* is from India and China, while *K. javanensis*, the smallest form, inhabits the East Indies and Malay Peninsula.



FIG. 154. — Leg of *Scotopelia ussheri*, showing spicules.

The horned-owls of the genus *Bubo*, inhabiting nearly all parts of the world except Australia, are remarkable for their large size and great strength, as well as for the great development of the plumicorns or ear-tufts. The number of species is variously estimated at from half a dozen to two or three dozen.

Good representatives of these magnificent owls are the great horned-owl, *Bubo virginianus*, of America, and the eagle-owl, *B. ignavus* (or *maximus*), of the northern parts of the Old World. The latter is probably as large as any in the genus, and one of the very largest of all owls, slightly exceeded in linear dimensions, perhaps, by one or two others, but in strength and prowess surpassed by none. An adult female measures about twenty-six inches from bill to tip of tail; the wing is from eighteen to nineteen inches in length, and the plumicorns from three to three and a half. The weight of such a bird in fair condition is nearly eight pounds. As in all the members of the genus, the tarsi are well feathered, the facial disk is imperfect, the part below the eye much exceeding in area that above it, and the plumage is of a mottled character, — black, white, and various shades of brown being the prevailing colors.

The eagle-owl is now extremely rare in Great Britain, but in mountainous and

wooded regions of the rest of Europe it is rather common, breeding abundantly in Scandinavia, in Spain, on the wooded slopes of the Urals, and thence eastward across Siberia to China. In many parts of Germany it is still common, but probably decreasing steadily in numbers. According to Dresser, "An official list states that two hundred and two specimens were killed in Bohemia in 1857, which appears almost doubtful, though the total number of owls of all sorts killed there is in the same list stated to be eight thousand six hundred and seventy." According to the same



FIG. 155. — *Bubo ignavus*, eagle-owl.

author, this bird is one of the boldest and most rapacious of European birds of prey, being a match even for the eagle. Yet, though it sees well in the daytime, it is frequently chased about and stooped at by peregrines and smaller falcons, until compelled to seek safety in a dense thicket or beneath a projecting rock.

"Usually it remains quiet during the day, hidden in some dark ravine or dense forest, but often appears about in search of prey quite early in the evening, before the twilight has set in. Its flight, like that of all the owls, is noiseless and powerful; and

its note, a deep and loud hoot, consisting of the syllables *hou, hou*, modulated in various ways, can be heard at considerable distances. Uttered at night, from some dark, gloomy-looking gorge, the gruff call-note of the eagle-owl sounds peculiarly weird and wild. It occasionally varies its usual note, so that it may be sometimes likened to a hoarse laugh, and at others it is not much unlike the neighing of a horse. The superstitious peasants in the north believe, when they hear the hoot of this owl, that evil spirits are about; and the various legends of the wild huntsman, the so-called 'wilde Jagd,' so firmly believed in by many of the German peasants, doubtless have their origin from this bird. Few birds of prey are so destructive to game as the present species; for there is no game-bird, not even the capercaillie, which is too large for him, and he does not disdain to hunt after the smaller species also; mice and rats, hares, rabbits, young fawns, black-game, pheasants, partridges, and hazel-grouse, all are equally good in his sight, and form a portion of his daily diet when obtainable; but jays, and especially crows, appear to be favorite articles of food with him, and remains of the latter are very frequently met with in his larder."

It seems ordinarily to prefer for nesting purposes a ledge of rock, or some cranny in the face of a cliff, yet in forest regions it is known to nest in trees or even on the ground; and, in the treeless downs of Turkey, according to Messrs. Elwes and Buckley, "it chooses a bank of earth on the side of a ravine for its eyry, and scratches out a hole for the eggs in the bare ground, sometimes within sight of every passer-by. We found a nest of four hard-set eggs on April 8th, and others containing young birds a fortnight later." It also breeds freely in confinement, and in some places in England has been almost domesticated. According to Mr. Gurney, forty-nine young have been reared from a single pair between 1849 and 1873, this pair having laid, in all, seventy-one good eggs and several bad ones.

The American great horned-owl, *Bubo virginianus*, is quite similar in general appearance to the bird just described, but is decidedly smaller, the total length being from four to six inches less, the wings shorter by three inches or more, and other parts in proportion. While the colors themselves are much as in *ignarus*, the pattern is quite different, the lower parts, instead of being streaked and spotted, are barred with black, there is a black ring nearly encircling the facial disk, and a large, pure white patch on the upper breast and throat.

This fine owl is far more abundant in the eastern United States than is generally supposed, and it is probable that there are very few townships in which there are any considerable stretches of woodland where it is not resident. In its habits it is much like the eagle-owl, preying not only on large game, such as hares, grouse, and, according to Audubon, turkeys; but also on rats, field-mice, reptiles, and fish. Although its disposition can hardly be called gentle or affectionate, and it is less easily managed than the snowy-owl, it is far from being always the "fierce and untamable" bird which it has so often been described. Dr. Coues took a pair of young at Pembina, Dakota, which were still in the white down. He kept them through the entire summer, and they became quite tame. We extract the following from his account:—

"They became so thoroughly tame, that, as their wings grew, enabling them to take short flights, I used to release them in the evening from the tether by which they were usually confined. They enjoyed the liberty, and eventually used to stay away all night, doubtless foraging for themselves for their natural prey, and returning to their shelter behind my tent in the morning.

"These owls were most active during the night; yet it would be a great mistake

to suppose their vision is much restricted in the daytime, notwithstanding they belong to a group of owls commonly regarded as nocturnal. They passed most of the day, indeed, crouching in the shadow of the tent, and it was only toward sundown that they became active, flying the length of their tether in the attempt to reach the ridge of the tent; yet their vision was acute at all hours. I often saw them look up and follow with their eyes the motions of a grasshopper or butterfly flickering several yards up in the air. On one occasion in particular, I saw them both gazing steadfastly, and on looking up to see what had attracted their attention, I was myself blinded by the glare, for the direction was exactly in the sun's eye. But a few moments afterwards I discovered a pair of white cranes floating in circles half a mile high. The owl's eyes endured a glare that my own could not, and the birds certainly saw the objects, for they slowly moved the head as the cranes passed over. The best of the supposed performances of an eagle soaring in the sun's eye could not excel this. Nor was the inner eyelid drawn over the ball to shade it. I had abundant evidence, on this and numerous other occasions, that the movements of the birds' iris are entirely under the control of the will, instead, as commonly supposed, of being automatic, depending upon the stimulus of light. I frequently saw them instantaneously relax or contract the quivering iris in accommodating their vision to different objects or different distances; and, moreover, they could move the irides independently of each other; for they often looked at objects with one eye only, the other being sleepily half closed; and on such occasions the pupils were generally of different sizes. They varied in diameter from that of a small split-pea, to that of a finger-ring; in the latter condition the iris was a mere margin about a tenth of an inch in diameter. In the night-time I always found the pupil largely, if not fully, dilated; at every stage of contraction it remained perfectly circular."

Others have been less successful in taming these birds, some failing entirely, others making but a partial success. In the "Auk," Mr. J. W. Banks has given some of his experience in this respect, together with many interesting notes, from which we select the following: "Nothing in the shape of fresh fish or flesh is neglected by the owl when hungry, though her choice is for wild birds, and she will take small animals in preference to beef or mutton. A rat or squirrel is always swallowed whole, and about every second or third day the fur and bones are ejected, rolled into a hard pellet as large as a grouse's egg. Just before ejecting these pellets the bird's appearance is very distressing. The first time I observed it I thought she must be ill, but as soon as the pellet is out she immediately recovers. The 'hoot' is made with the bill firmly closed; the air is forced into the mouth and upper part of the throat, the latter being puffed out to the size of a large orange."

The breeding habits of the great horned-owl vary widely in different parts of the country. Audubon's experience led him to believe that it nested usually in hollow trees, but in two cases he knew it to nest in the clefts of rocks. In many parts of the United States it builds a large, open nest, toward the top of a tall tree; this seems to be usually the case in New England, where the eggs are ordinarily but two (rarely three and never more) and are laid between the middle of February and the middle of March.

At that early date there is often scarcely a sign of spring and the eggs must need constant care to prevent freezing. The late Mr. W. W. Coe, of Portland, Conn., who took one or more sets of this bird's eggs every season for many years, informed us that one morning, after a heavy fall of snow, he saw in the top of a tree, while trying to

locate a nest, what he supposed to be an old nest, as it was heaped high with snow. While looking at it doubtfully, however, his companion struck the butt of the tree a heavy blow with a club, and to his surprise the snowy covering of the nest was lifted on the wings of the sitting bird, and scattered in a cloud as she hastily sped away."

The American horned-owl has a very extensive range, as it is found from the shores of the Arctic sea to Cape Horn, and although it presents considerable variations in size and color, very few forms seem to be constant enough for recognition as races. Specimens have been taken in which the color is so dark as to strongly suggest melanism, while the other extreme is seen in specimens from the far north or the Alpine levels of the mountains, which occasionally resemble quite closely, except for the plumicorns, the snowy-owl.

The dusky horned-owl of India, *Bubo coromandus*, is interesting from the fact that several instances are on record of its laying distinctly spotted eggs, though ordinarily its eggs, like those of all other owls, are pure, unspotted white.

Miniatures of the great horned-owls are the little horned-owls, or Scops owls as they are frequently called, from the genus *Scops* to which they all belong. They agree with the members of the genus *Bubo* in most of the characters of that genus except size; the facial disk being imperfect in the same way and to about the same extent, the plumicorns prominent, and the colors similar. The wings are said to be proportionally longer, but this is not very obvious in the best figures we have seen, and even the measurements do not always bear out the statement. The toes, however, are more often bare in *Scops* than in *Bubo*, and this nakedness frequently extends some distance up the tarsus, in one or two species even half its length. Moreover, the Scops owls frequently show marked dichromatism, which the species of *Bubo* never do, and all the former are of small size, the largest not exceeding a foot in length, and the average being only from six to seven inches.

Mr. R. B. Sharpe, in his catalogue of the birds of prey in the British Museum, thus speaks of this group. "Difficult to understand as all owls are, the species of the genus *Scops* are in every way the most difficult to identify. The impossibility of procuring series of some of the species to study at the same time, the absence of information as to the sequence of plumages from the young stage to that of the adult, and the puzzling way in which some species seem to possess rufous phases, while others do not,—these are all problems which time alone can solve. I can hardly expect that all ornithologists will acquiesce in my views as to the sub-species or races which I have believed it to be my duty to recognize. These races *do* exist in nature, and they may be called by whatever name naturalists please, 'varieties,' 'races,' 'sub-species,' 'climatic forms,' etc.; but it has seemed to me better to keep these forms, many of which are very well characterized, distinct from one another, than to merge them all as one species, and thus to obliterate all records of *natural facts*, which are plain enough to the practiced eye of the ornithologist, though difficult to describe in words."

Mr. Sharpe then proceeds to characterize upwards of twenty-five species, and more than the same number of sub-species or races; about one quarter of the whole being found in America, and the rest in the Old World, excluding Australia and Oceania, where none are known to occur. It is, of course, impossible for us to name these here, or to go into questions of the validity of species, the relationships of races, etc. Mr. Sharpe, however, includes in the genus two owls which are perhaps better separated under the generic title *Lophostrix*, and which in size stand between *Bubo* and *Scops*, but rather nearer the former, having a length of from sixteen to twenty inches, and

the other dimensions in proportion. The plumicorns are about two inches long, and the genus is peculiar to tropical America.

A fair representative of the remaining species is the common mottled-owl or screech-owl, *Scops asio*, so generally distributed through the United States, where it is one of the commonest of the smaller species, and, except along our southern border, the only small owl which has plumicorns. It shows in its perfection the dimorphism which is so common in this genus as well as in *Glaucidium* and several others, but its habits appear to be about the same everywhere.

It is strictly nocturnal, or crepuscular, feeds mostly on mice and similar vermin, and almost invariably nests in the hollows of trees, where it lays five or six eggs in April or May in the Middle and New England states. While its food is doubtless mainly as mentioned above, yet it eats many insects, probably catches small birds occasionally, and would seem to be fond of fish from the following account by Mr. A. M. Frazar, of Watertown, Mass. Mr. Frazar says: "On November 29, 1876, I took from a mottled owl's hole the hinder half of a woodcock, *Philohela minor*. Within two weeks after I took two owls from the same hole, and on the 19th of January last I had the good fortune to take another. After extracting the owl I put in my hand to see what else there was of interest, and found sixteen horned-pouts, *Amiurus atrarius*, four of which were alive. When it occurred to me that all the ponds in the vicinity were under at least two feet of snow and ice, I could scarcely conjecture where the horned-pouts could have been captured. After visiting all the ponds, I found they had most probably been captured in one fully a mile away, where some boys had been cutting holes through the ice to catch pickerel bait. The owl probably stationed himself by the edge of the hole and seized the fish as they came to the surface. What a busy time he must have had flying thirty-two miles after sixteen horned-pouts!"

The ordinary cry of the mottled-owl is a tremulous and not unmusical series of notes, and we have never heard a note from this species which would at all justify the common name of screech-owl.

A beautiful Mexican and Central American species is the flammulated-owl, *Scops flammeolus*, which has been taken half a dozen times or more in California, Arizona, and Colorado, and in the last-named state has been found breeding. This is one of the smallest species of the genus, and readily distinguished from *S. asio* by its perfectly bare toes and very short plumicorns.

The common species of Europe is the scops owl, *Scops giu*, which is slightly smaller than our common mottled-owl, and differs further in its naked toes. In general appearance and plumage, however, they are quite similar, though specific characters for their separation are easily found, and it has even been proposed to place the American birds of this genus in a separate sub-genus, from that which should include *S. giu*. In habits all the species seem to be quite similar; essentially nocturnal, and rarely nest-

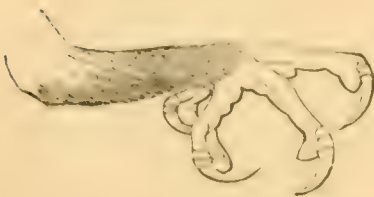


FIG. 156. — Foot of *Scops giu*.

ing anywhere except in hollow trees or deserted woodpeckers' holes, though *S. giu* has been known to lay its eggs in the deserted open nest of another bird, in a thick evergreen tree.

We now come to a group of three genera, in which the facial disk is very highly

developed, and extends equally above and below the eye, so that this organ is really situated in its centre. The external conch of the ear is very large, and provided with an ample operculum or flap, by which it can be completely closed at pleasure. Most of the species are strictly nocturnal.

The first genus, *Asio* or *Otus*, contains but very few species, among which we may mention first the long-eared owl, *Asio otus* (*Otus vulgaris*), common to nearly all the countries of the northern hemisphere, but only found in woods, where it usually remains quiet by day, hunting entirely at night. The plumicorns are very long in this species, and are habitually carried erect. It is a plentiful bird in the United States, and, though most abundant during the migrations, is probably sparingly resident in most wooded regions, and breeds. It usually selects for this purpose the old nest of a crow or hawk, but probably sometimes builds for itself. Dr. Brewer, in describing its breeding habits as observed by Dr. Cooper near San Diego, California, says: "On the 27th of March he found a nest — probably that of a crow — built in a low evergreen oak, in which a female owl was sitting on five eggs then partly hatched. The bird was quite bold, flew round him, snapping her bill at him, and tried to draw him away from the nest, the female imitating the cries of wounded birds with remarkable accuracy, showing a power of voice not supposed to exist in owls, but more in the manner of a parrot." The European and American birds differ slightly, the latter being, as usual, rather darker. Another peculiar species, *Asio stygius*, is found in South America.

The short-eared owl, *Asio accipitrinus* (*Otus brachyotus*), is closely related to the preceding, but differs widely in appearance, the plumicorns being very short, and often hardly appreciable. This species probably has the widest range of any known owl, being found all over Europe, Asia, and a large part of Africa, and in both North and South America as well as in the Falkland and Hawaiian islands; and, contrary to the usual rule among owls, it differs but very slightly in size or coloration in different parts of its range.

It is one of the few species exclusively inhabiting open country, preferring meadows or uplands covered with rank grass, and in such situations its nest is usually built. This is commonly but a shallow cavity scratched in the ground, and lined or surrounded with a few leaves or grass stems, and contains from four to seven eggs. While this is probably its ordinary mode of nesting, Mr. Dall found it breeding in burrows in the sides of steep banks on the island of Unalashka, the nest placed at the end of the burrow, and from one to two feet from the entrance. This bird ranges far into the Arctic regions, and its migrations are performed with considerable regularity.

In winter, wherever it is found, it seems somewhat gregarious, and usually several individuals will be found resting near each other in the grass during the day. Sometimes they appear in unusual numbers, an instance of this kind having been observed by Mr. W. E. D. Scott, near Princeton, N. J., in the autumn of 1878. He says: "I am informed by most credible witnesses that late in October, or about November 1, there appeared in a field of about forty acres, which was covered with a heavy growth of long, dead grass, vast numbers of owls. A visit to the field in question, which is directly adjacent to the railroad depot at Harlingen, and a talk with farmers living close by, gave me the following additional data: The birds were exclusively the short-eared owl (*Brachyotus palustris*), as I learned from an examination of specimens in the possession of several farmers. Their number was variously estimated at from a hundred and fifty to two hundred. Many were shot, and, as some are still to be found

in the field in question, I should think this locality had been fixed on as a wintering point. There are no trees in the field, and in the daytime the birds rest on the ground. They hunt for food morning and evening, and sometimes on dark days. Throughout this and adjoining townships these owls have been more or less common, and many have been brought in by gunners. In previous years I have looked on this species as rather rare, and some seasons have passed without my meeting with them. Since writing the above, two other points, at which vast numbers of these birds have congregated, have come to my knowledge, and in each case the conditions of locality are identical with those above described."

The genus *Nyctale* includes, probably, but two species, viz., Tengmalm's owl, *N. tengmalmi*, of Europe (Fig. 152), with its American race, called Richardson's owl, and the Acadian or saw-whet owl, *N. acadica*, which is peculiar to North America. The genus is marked by its untufted head, heavily feathered feet and toes, and small size. The skull also is extremely asymmetrical, and especially the ears.

Richardson's owl is one of the rarest species occurring within the limits of the United States, being only seen there in winter, and very few specimens being taken then. Further north it is more common, but its habits, especially in the breeding season, are little known. Dr. C. H. Merriam gives the following note on it, as observed by Mr. Comeau, at Godbout, on the north shore of the St. Lawrence River, at its junction with the Gulf. "A common winter resident and very tame. This owl has a low, liquid note that resembles the sound produced by water slowly dropping from a height; hence the Montagne Indians call it *pillip-pile-tshish*, which means 'water-dripping bird.' These Indians have a legend that this was at one time the largest owl in the world, and that it had a very loud voice. It one day perched itself near a large waterfall and tried not only to imitate the sound of the fall, but also to drown the roaring of the torrent in its own voice. At this the Great Spirit was offended, and transformed it into a pigmy, causing its voice to resemble slowly dripping water instead of the mighty roar of a cataract."

It is a little larger than the mottled owl, and, besides lacking the plumicorns, it is at once distinguished by its chocolate-brown color above, spotted with white, and the white under parts striped lengthwise with brown.

The Acadian owl, *Nyctale acadica*, is little more than half the size of Richardson's owl, which it resembles considerably in color. It seems to be less northerly in its distribution, and, although nowhere very abundant, it is pretty generally distributed over the United States, and extends southward into Mexico. The young, in its first plumage after the down, is a very different looking bird from the adult, being pretty uniform olive-brown all over, but paler on the lower breast and belly, the wings and tail with indications of white bars, and the eyebrows pure white, in strong contrast to the surrounding dark color. From this last-named mark it took its name of white-fronted owl, and was for years believed to be a genuine species, distinct from *acadica*, and passing under the name of *albifrons*. Specimens of this kind, however, when kept in confinement, speedily moulted into the full plumage of *acadica*, and thus settled the question which had already been raised as to their specific identity. The name 'saw-whet' is derived from the supposed resemblance of some notes of the bird to the sounds produced in filing a saw, but it seems probable that, in order to appreciate the strong resemblance, the listener's imagination needs to be whetted at the same time.

This species is supposed to nest invariably in holes of trees, but it is not impossible that it may sometimes use the deserted nest of some other bird, or even itself build a

nest in the crotch of a tree, as Richardson's owl is said to do. Mr. W. Perham, at Tyngsboro, Mass., has been quite successful in taking eggs of this bird by hanging up in the woods breeding-places made of sections of hollow trunks, with the ends boarded up, and entrance-holes cut in the sides. In this way he has taken many nests of mottled owls, and occasionally one of the present species breeds in the artificial nest.

Mr. William Brewster, who has published the above facts, has also given his own experience with some of the young birds, furnished him by Mr. Perham which he kept alive for some months. He says they ate all kinds of meat with avidity, but seemed especially fond of mice. "The latter were invariably skinned, and the flesh torn in shreds and devoured, the skins being swallowed afterwards as dessert. I often saw them eject those peculiar pellets of bones, fur, and other indigestible fragments which all owls and many hawks are in the habit of depositing about their haunts. The operation was a peculiar one. The owl would gape several times, then the head would be violently shaken sideways, and, finally, the pellet, coated with mucus, would shoot forth, frequently falling several inches in front of the spot where the bird was sitting." These young birds were taken from the nest about the 15th of May, and three of them were 'prepared' while in the '*albifrons*' stage, and the remaining one had assumed the perfect plumage of the adult *acadica* by September 1.

The last group of the sub-family Striginae which we shall mention is the genus *Syrnium*, in which the facial disk reaches its highest development, and the species, as a whole, are quite nocturnal. The skull is quite symmetrical, and the species—of which there are from fifteen to thirty, inhabiting all parts of the world except Australia, Malaysia, and Oceania—are of large size.

The type of the genus, and also of the sub-family, is *Syrnium aluco*, the well-known brown or tawny owl of Europe, formerly one of the commonest birds of prey in Great Britain, but now far less abundant. It is a large bird, measuring eighteen or twenty inches in length, and is noted for its almost insatiable appetite and the consequent havoc it makes among small mammals and birds. It usually nests in hollow trees, but several authentic instances are on record of its breeding in rabbit-burrows. One of the more recent of these cases (1879) occurred in Kilmory, Lochgilphead, Scotland, and Professor Newton remarks that it may have been due to the paucity in that neighborhood of hard-wood trees of sufficient age and size to furnish holes or hollow trunks, and that the habit may be in process of becoming hereditary.

The barred owl, *S. nebulosum*, of North America is of about the same size as the brown owl, and is an abundant bird in wooded regions of the eastern United States, being very abundant in the Gulf States, and especially in Florida and Louisiana. It usually nests in hollow trees, but not unfrequently, especially in the northern States, in the old nest of a hawk or other large bird.

One of the largest and finest birds of prey, and a fitting one with which to close our account of the Striginae, is the great gray-owl, *Syrnium cinereum*, an extremely rare winter visitor to the northern United States, probably only resident within our borders in Washington Territory. It is one of the species common to the northern parts of both hemispheres, and the American race differs only in darker colors from *S. lapponicum* of North Europe and Asia, figured on page 335.

This magnificent bird measures from twenty-eight to thirty inches in length, and its color is dark brown above, with whitish mottling on every feather; and below, grayish white, the breast streaked, and the abdomen finely barred with deep brown.

In the northern parts of the continent it is rather abundant, and, although fitted for

a nocturnal life, it of necessity hunts by daylight during the summer. But as it is essentially a forest bird it keeps in the shadow of the trees as much as possible, and has been observed to be most active when the sun is at its lowest point. Its food is stated to consist largely of hares and smaller mammals, but in Alaska Mr. Dall found it feeding almost entirely on birds.

The structure and affinities of the singular East Indian *Phodilus* (or *Photodilus*) have already been briefly alluded to, and, as we are unable to present any account of its habits, we need only add here that the single species, *P. badius*, is a native of the eastern parts of India, and has been found in Ceylon, Java, and Borneo.

The barn-owls (sub-family *Aluconinae*) form a small group, the members of which resemble each other very closely, while they differ strikingly from all other owls. We have already shown how different is their bony structure, and their superficial appearance is equally remarkable. The facial disk here reaches its highest development, but instead of being more or less circular, as in all other owls where it is well developed, it is elongated and almost triangular, giving the face a most remarkable expression, not distantly resembling that of some monkeys. Moreover, the head is much produced in front, the bill being much longer proportionally than in other owls, while the legs are also long and scantily feathered, and the grotesque movements and strange postures which the bird assumes still further increase its singularity of appearance. The type of the sub-family is the European barn- or screech-owl, *Aluco flammeus*, represented in North America by a slightly different form, the race or sub-species *pratincola* of most authors.

The barn-owl has a remarkably wide distribution, its range being greater than that of any other owl. It is not found in New Zealand; in America it does not ordinarily pass north of latitude 45°, and is unknown in Scandinavia, but with these exceptions it probably occurs all over the world.

Correlated with this extensive range, we find great variability, and many of the more or less permanent 'varieties' or races have long been considered true species. Thus North American birds are almost invariably darker than average European ones; but a dark phase very like that of the American bird sometimes occurs in Germany or England, while specimens from the West Indies are fully as light colored as the lightest European ones, and about equalled in this respect by Australian birds. Not only do the colors vary in kind and intensity, but the pattern of coloration is somewhat variable; some birds being irregularly barred below, others spotted, and still others immaculate white. In most of the races the tail has from four to six dark bars, but Jamaican birds have the tail pure white, and English ones almost so. There is, furthermore, considerable difference in size, and some slight difference in the proportions of parts. The smallest birds are probably those of Europe, scarcely exceeded, however, by the South American form, while the North American birds are much larger than the European, and these again are far excelled by those of Java and Australia.

All these forms and many others were formerly ranked as so many separate species, but out of fifteen or twenty names in general use a score of years ago for forms then considered specifically distinct, all but four or five are now pretty generally admitted to indicate only geographical races, or light and dark phases of the single species, *Aluco flammeus*. These four or five seem to differ more strongly from the common type than any of the others, but it is noticeable that even here the differences are entirely of degree, and not of kind; the principal points being depth of color, degree of spotting, and size or shape of spots.

To these must be added the wide differences in size, but these lose much of their significance in view of the very great variation in this respect among the different races of *flammeus*. A small specimen of the European barn-owl (typical *flammeus*) is perhaps not more than thirteen inches long, with a wing measuring eleven inches and tail five. Its general color may be very nearly white, especially below; the tail perfectly white, or with only the faintest suggestion of orange, without dark bars. The back and upper surface of wings is pale orange or buff, delicately mottled with silver



FIG. 157. — *Aluco flammeus*, barn-owl.

gray, and with many distinct white spots, each accompanied by a black one. Compare such a bird with a large female of the barn-owl of Van Dieman's Land, *A. castanops*. The latter is twenty or twenty-one inches long; the wing measures from fourteen to fifteen inches, and the tail about eight. The lower parts are "deep golden buff," with spots and bars of blackish; the upper parts, including the wings, chocolate brown; the tail even darker, but crossed with five or six bars of "golden buff," while the face, instead of being pure white as in *flammeus*, is light chestnut, with a black patch in front of the eye.

They certainly appear very different, but when we find that they are, perhaps, the two most different individuals which we could have selected, and that between them we can place forms which shall connect them by almost every possible gradation of color and size, we ought to feel less certain of their specific distinctness than we did at first. It is to be borne in mind that among owls the sexes usually differ very much in size, though they are not known to differ materially in plumage; and it is also significant that the species of *Aluco* still considered distinct from *flammeus* are mostly but slightly known, and are comparatively rare in collections. Hence, in considering the habits of the birds of this genus, we shall ignore the rarer members, and speak simply of the barn-owl, meaning thereby *A. flammeus*, or any of its races. And first we might remark that the more appropriate name for this bird is the screech-owl, for certainly, of all the owls we have ever listened to, this one has the most typical and unearthly screech. It may roost in a barn or a ruined castle in England, or lay its eggs in the cathedral belfries of France and Italy, or the unused loft of a tobacco or sugar warehouse in our own southern states; the hollow stub beside a marsh may cradle its young in Pennsylvania or Australia; it may burrow in a sand or clay bank in Texas, or breed in the chinks and fissures of cliffs in California, or in the open fork of a banyan tree in the Philippine Islands; but, disturb it by night near any of these its chosen haunts, and its startling cry of dismay, derision, or defiance as it vanishes, will always be a harsh and rasping screech.

From the above remarks it will be seen that the nesting habits of this bird are extremely various. Perhaps it may be said most often to nest in or about buildings, and this seems to be its habit in most parts of the United States, though in many sections it is known to nest in hollow trees, and in parts of Texas it breeds abundantly in holes in the banks of rivers. Three seems to be the common number of eggs hatched at once, but there is considerable evidence to show that other eggs are often laid after the first are hatched, and there are many unsettled questions with regard to the economy of the species. Its eggs have been found in the United States in almost every month of the year, and it is not impossible that, as Audubon was assured in Florida, these owls, like the house-pigeons, breed at all seasons of the year. In Charleston, S. C., in October, Audubon found young several weeks old and kept watch of them for several months, during which time they were fed by their parents exclusively on small quadrupeds, mostly cotton rats. When he first saw the young they were clothed with a rich, cream-colored down, and even when three months old this had not all given place to true feathers. Although hatched early in October, they were unable to fly by the middle of January, though apparently well fledged.

In the eastern United States this bird is abundant only toward the south. In New England it is very rare, and, though there is an unchallenged record of its capture in Hamilton, Ontario, in May, 1882, it is not known ever to have occurred in Maine, though on the Pacific coast it is abundant in California, and extends as far north as the mouth of the Columbia. It is an interesting and valuable bird, unquestionably beneficial from the numbers of small rodents it destroys, and, like many other of our owls, deserving of every protection and encouragement which will increase its frequency in and about our homes.

The only other member of this sub-family at present known is a newly discovered Madagascan genus, the type of which has been recently described by Alphonse Milne-Edwards under the name *Heliodilus soumagnii*.

WALTER B. BARROWS.

ORDER XVI.—PSITTACI.

The parrots, though a group so well defined that the merest tyro at once recognizes their limits, have made no little trouble for the systematic ornithologist. Characters which in other birds are deemed even of ordinal importance here vary in the most curious manner within the limits of one genus, thus giving rise to the greatest differences in the systematic arrangement of the group. These superficial characters which at once, and so forcibly, strike the observer are, however, accompanied by certain constant internal features of far more importance, so that the group is a wholly natural one. Only a few of these need concern us here.

The parrots have the bill short and stout, the upper half extending beyond and turning down over the lower. At the base of the bill is frequently seen a peculiar wax-like patch (the cere), through which the nostrils open; this cere is always present, though frequently it is concealed by the feathers. In the feet also, we notice a peculiarity which we have not before met in the course of our survey of the birds, but which will reappear again in some of the following groups. This is the fact that two of the toes (first and fourth) are directed backwards, while the other two extend forward in a normal manner. The tongue is usually large and fleshy, and serves to some extent as an organ of prehension. The upper mandible is loosely articulated with the skull; the furculum or wish-bone is weak or wanting. The primaries and tail feathers are each ten in number.

The grouping of the parrots is in a state of dire confusion. The late Mr. A. H. Garrod, the former protector of the Zoological Society of London, proposed a scheme in 1874, based upon the dissections of the muscular system and the carotid arteries of some eighty-two species, representing thirty-eight genera and sub-genera. In this the carotid arteries were given primary importance, and the ambiens muscle was nearly equal in systematic value. The results, however, were far from satisfactory. Besides not being consistent with itself, it widely divorced species belonging to the same genus, and when tested by geographical distribution gave the most astonishing results. Though far from perfect, the arrangement of Dr. Reichenow is better than any of its predecessors, and for that reason we adopt it here, though without accepting all of its details.

The number of species of parrots is about four hundred and thirty, and these are arranged in nine families and forty-five genera. The parrots are mostly inhabitants of tropical climates, though many extend beyond the torrid zone. Our Carolina parakeet reaches the furthest north, while in the Australasian region forms extend to Auckland and Macquarie Islands (55° S.). It is usually stated that the American continent is richest in species. This statement, however, is erroneous. According to Reichenow's lists (1881), the American continent contains one hundred and twenty-six species and sub-species, while the Australasian region (south and east of Wallace's line) affords a home for nearly one hundred and fifty forms.

Most of the parrots have a brilliant plumage, in some the display of colors being such as to afford very unpleasant contrasts; others are clothed in feathers so quiet in hue as to give no offence to any member of the Society of Friends. In size considerable variation is to be seen. The love-birds are hardly larger than sparrows, while the great macaws (*Sittace*) measure three feet from the tip of the bill to the end of the

tail. Parrots usually associate together in large flocks, some living in forests, others on grassy plains. Their food is mostly of a vegetable nature, buds, leaves, seeds, fruit, and the like.

Their natural voice is usually harsh and discordant, but many of the species, as is well known, possess great imitative powers, learning not only to repeat long sentences but also to reproduce the most complex sounds which they may hear. Capacity in this direction varies not only with the species but with the individual.

Concerning the conversational powers of parrots, page after page could be written; many of their sayings seem so apt that one can hardly escape the belief that they reason as well as talk. Instance after instance is on record where it would almost seem as if these birds took circumstances into consideration and knew the full force of what they were saying. Notwithstanding the limitations of space, one of these must be quoted here. Mr. Sharpe of the British Museum is the authority for the following: "A friend in Manchester told the writer of a parrot-show in the north of England, where the talking powers of each bird were made the subject of a prize competition. Several of the birds had exhibited their powers, and at last the cover was removed from the cage of a gray parrot, who at once exclaimed, on seeing the company to which he was suddenly introduced, 'By Jove! what a lot of parrots,' an observation which gained him the prize at once."

The owl-parrots of New Zealand and Australia are admitted by all to stand at the bottom of the Psittacine series, where they form the family *STRINGOPIDÆ*, of which but four species are known. They have a short, thick, untoothed beak; short wings which reach to the base of the rounded tail; the nostrils free, and surrounded by a swollen margin. The feathers are banded and spotted with yellow, green, and black.

Of the genus *Stringops* two species, both from New Zealand, are known, but one of these (*S. greyi*) is possibly extinct. The genus may be recognized by its moderately sized head, the long and stiff feathers on the face, the grooves on the sides of the bill, and by having the fourth and fifth, or fourth, fifth, and sixth wing feathers the longest, and the tail feathers pointed. The species rarely fly, and, from the effects of disuse, the keel of the sternum, so greatly developed in most birds, has disappeared, and the furculum is wanting.

The owl-parrot, or kakapo (*Stringops habroptilus*), is interesting from its habits and appearance, combining as it does to a considerable extent those of the owls as well as of the parrots. It was first known from feathers in the possession of the Maori, and it was not until 1845 that specimens came to the hands of naturalists. It is largely though not exclusively nocturnal, and is a vegetarian, feeding on roots as well as on leaves and tender twigs. In color it is green with longitudinal dashes of yellow, and with interrupted cross-bars of black. Around the eyes are discs like those of the owls, and here the feathers are a light yellowish brown. The irides are dark brown or black.

Sir George Gray and Mr. A. G. Sale have written interesting accounts of this species, and from that of the latter gentleman we make the following extract: "During the whole time that this bird has been in my possession, it has never shown the slightest sign of ill-temper, but has invariably been good-humored and eager to receive any attention. Its playfulness is remarkable. It will run from a corner of the room, seize my hand with claws and beak, and tumble over and over with it, exactly like a kitten, and then rush back to be invited to a fresh attack. . . . It has also, apparently, a strong sense of humor. I have sometimes amused myself by plac-

ing a dog or cat close to its cage, and it has danced backwards and forwards with out-stretched wings, evidently with the intention of shamming anger, and has testified its glee at the success of the manœuvre by the most absurd and grotesque attitudes. One trick especially it has, which it almost invariably uses when pleased, and that is to march about with its head twisted round, and its beak in the air,—wishing, I suppose, to see how things look wrong way up, or perhaps it wishes to fancy itself in New Zealand again.”



FIG. 158. — *Stringops habroptilus*, owl-parrot.

The kakapo is described as very intelligent, and would make a nice pet were it more cleanly in its habits. Its nest is placed under trees and rocks, and in it, it lays two or three white eggs. It lives in holes in the ground, and its flight is described to be much like that of the flying squirrel. Since the advent of the whites, and the escape into the country of cats, dogs, and rats, these parrots have decreased in number, and their extinction is but a matter of time.

The single species of *Geopsittacus* (*G. occidentalis*) is the ground-parrot of southern and western Australia. Little is known of its habits, which are said to resemble

those of the kakapo. It has an extraordinarily large head. *Pezoporus formosus* occupies the same regions as *Geopsittacus*, and extends across to Tasmania. It has longer wings, the second and third quills being the longest.

The cockatoos, forming the family PICTOLOPHIDÆ, are mostly confined to the East Indian Archipelago, Papua, and Australia. One of the most striking features is the crown of erectile feathers on the heads of most of the species. When quiet these are usually but little conspicuous; but when something excites the bird, up they are raised, completely changing the whole aspect of their possessor. The beak is strong, about as high as long, its upper half usually flattened or keeled, or, rarely, rounded above. Its cutting edge is excavated behind the point. The cere may be naked or feathered. The wings are long and pointed, and, when at rest, they cover half or more than half of the tail. The tail may be either short or long, and its extremity straight or rounded; never graduated or wedge-shaped.

The prevailing color of the plumage is white, black, or brown. The latter color occurs in *Nestor*. White is found as a predominant color in no other family, while black exists only in *Chalcopsittacus* (one of the lories), and in *Coracopsis* (one of the gray parrots). The females are colored like the males, but are recognizable from their smaller size and shorter crown feathers. All are large forms, none being smaller than doves. The common name, cockatoo, is a good phonetic reproduction of the common note of many of the species.

In their habits they are very social. Not only at the breeding season, but at all times of the year, they form great flocks, usually living in the tops of the highest trees of their tropical homes. Their nests are built in hollow trees, or in clefts of the high, rocky cliffs. They are vegetarians, and are especially fond of grain and fruits. Still, exceptions in this respect are to be noticed. *Licmetis* lives on roots and bulbs which it digs from the earth, while *Calyptrorhynchus*, with its strong beak, tears the bark and excavates the rotten wood of decayed trees in its search for insects and larvæ. *Nestor*, again, forms an exception which will be noticed below.

The family of cockatoos embraces thirty-two species, arranged in five genera. Apparently the extinct *Lophopsittacus mauritanicus* also belongs to the same family, although in some respects it is allied to the American genus *Sittace*.

All of the species of *Nestor*, except one from Papua, belong to the New Zealand fauna. They are the most aberrant members of the family, and in several respects differ from the diagnosis given above. They lack the long crown feathers of the others, have a tail only half as long as the wings, its extremity straight, an elongate bill, the upper half of which frequently extends quite a distance beyond the lower. Indeed, the whole facies of these birds is such that they are frequently arranged in the family Trichoglossidæ.

Half-way between New Zealand and New Caledonia are two small islands, Norfolk and Philip. On the latter is (or, rather, was) found the Philip Island parrot, *Nestor productus*. This small island has an area of only about five square miles, and only here occurred this species. Though Norfolk Island is distant but four miles, this parrot has never been found there. With this extremely restricted distribution it is no wonder that it has now become extinct. It was fond of soft, succulent vegetables, and was said, by the aid of its long hooked beak, to dig roots from the earth. Still, like all the genus, it was fond of honey and the nectar of flowers. In color it was brown above, red below, breast, throat, and cheeks yellow. The Norfolk Island parrot, *N. norfolkensis*, a similar species, with the top of the head green, is also said to be extinct.

In New Zealand the kaka parrot (*N. meridionalis*) has made itself something of a nuisance. Since these islands were settled, and sheep-raising has become a prominent industry, the kaka has largely forsaken its diet of fruit, vegetables, and honey, and developed into a bird of prey. Whenever a sheep dies in the fields, the kakas gather and devour its flesh. But they are not content with this. They are said to perch on the backs of the animals when alive, and, with their strong beaks, to tear out pieces of



FIG. 159. — *Ptilopus moluccensis*, rose-crested cockatoo.

flesh for food. The ordinary note of this species is said to resemble the bark of a small dog, but it is also capable of imitating other sounds, and, if properly taught, of talking.

Leionotis contains two long-billed, white species from Australia, popularly known as the slender-billed and the digging cockatoo (*L. neisicus* and *L. potitorius*). As the name indicates, one species digs in the earth for its food.

The true cockatoos belong to the genus *Cacatua* or *Ptilopus*. With two exceptions, the fifteen species are white. They have a short, high bill rounded or

grooved above, and hollowed below; the cere is naked or feathered, the tail is short and truncate, and a well developed crown is present. The genus embraces some fifteen species, and several well marked varieties, or, as they are called, sub-species; all come from the eastern islands extending from Malaysia to Australia.

Almost every menagerie and zoological garden boasts several species of this genus, those mentioned below being possibly the most common in confinement. They make very interesting pets, crying now "cockatoo," now "pretty cocky," or screaming with a voice far from musical.

The white-crested cockatoo (*P. albus*) comes from the Mollucca Islands. It is everywhere white except on the insides of some of the wing feathers. It reaches a length of about eighteen inches. Usually its conversational powers are rather limited, but occasionally specimens are seen which can talk considerably, but their voice is always loud.

Even more common is the yellow-crested cockatoo (*P. galerita*). It comes from Australia and Tasmania, and is the most docile of the genus. It is readily distinguished from the species just mentioned by the fact that the feathers of its crest are sulphur-yellow, and its size somewhat larger (about twenty-two inches). A third species, the pink cockatoo, receives its name (*P. leadbeateri*) from Mr. Leadbeater, an English naturalist, who owned the first specimen brought to Europe. The color is white above, slightly suffused with pink, while the crest is barred with crimson, yellow, and white. Below, the feathers are also crimson. In size it is intermediate between the two forms previously mentioned. The last species which our space will permit us to notice is the rose-crested or Mollucca cockatoo, *Plissolophus moluccensis*, a bird about the size of the great yellow-crested form, with a roseate or vermilion crest. As its name indicates, it comes from the Spice Islands.

In their native woods these cockatoos form large flocks, which raise an almost intolerable din. This is not their only fault, for in those regions where civilized man has settled, they commit no inconsiderable depredations on his fields. In the aviaries of a zoological garden, one can watch them for hours without tiring. At one moment they are climbing about quietly, using both beak and feet in the operation; the next instant they are all excitement, every feather is raised, and the crest is expanded and shut with considerable rapidity. Instead of the soft "cockatoo" which they were saying a moment before, they are yelling and screeching in a manner indicative of great passion. The cause of the anger, if anger it be, is usually some inconsiderable trifle, or possibly some person whose appearance or adornment does not suit them.

Passing by the seven species of helmeted cockatoos (*Calyptorhynchus*), all of which come from Australia or the adjacent islands, we close the family with the arara cockatoo, the only member of the genus *Microglossus*. Like most others of the genus, it has an erectile crest, but may be distinguished by its feathered cere, its bare cheeks, its sharp, toothed beak, and its long, rounded tail. This species (*M. aterrimus*), when adult, is black, but in its younger stages is banded with yellow. In absolute size it is the largest of parrots, measuring from twenty-eight to thirty-two inches in length, though some of the macaws, with their longer tails, exceed these dimensions, though with far smaller body. The great black cockatoo, or palm-cockatoo, as this species is also called, ranges from the Malayan Islands south to the north coast of Australia. The generic name, *Microglossus*, means little tongue, and is suggested by the peculiarities of that organ.

The PLATYCERCIDÆ have the short thick beak higher than long, its lower half

often completely hidden by feathers, the upper toothed or entire. The cere is small, frequently feathered to the nostrils, and more or less wrinkled; the tail is long, usually exceeding the pointed wings in length. All of the sixty-six species inhabit the eastern hemisphere, Australia forming the centre of their distribution. They are strong fliers, and live largely on the seeds of various grasses and other plants. They are not stationary, but move from place to place according to the abundance or scarcity of their favorite food. They place their nests in hollow gum-trees and



FIG. 160. — *Microglossus aterrimus*, black, or arara cockatoo.

Euphorbias. They are usually brilliantly colored, the two sexes differing in their ornamentation, and the female being smaller than the male. The young are usually colored like the female.

The three genera, *Melopsittacus*, *Callipsittacus*, and *Nanodes*, are Australian, and each contains but a single species. The zebra grass-parakeet, *M. undulatus*, is about seven inches long, yellowish green, with fine dark undulating lines on the head and neck, a patch of blue on the cheek, the upper parts brownish green, beneath grass-

green; the two middle tail feathers are blue, the rest green. It is one of the most abundant species in Australia, and has been exported in large numbers to England and America. Its natural voice instead of being a harsh screech is soft and musical, and the bird makes a pretty pet, frequently breeding in confinement.

The crested ground-parakeet (*Callipsittacus nova-hollandiae*) is mottled with brown, gray, and white, with a little yellow and red upon the head. Like the preceding it is a gregarious species, migrating to the north in February and March and



FIG. 161. — *Melopsittacus undulatus*, zebra grass-parakeet.

returning to the southern shore of the island continent in September. It runs well upon the ground, is far from shy, and is said to be very good for food.

The genus *Cyanorhynchus* contains fourteen species from South Seas, all brilliantly colored, and some of them noticeable for their extreme southern range, being found on Auckland and Macquarie Island, away to the south of New Zealand. The grass-parakeets of the genus *Euphonia*, seven in number, are bright-colored and occur in Australia and Tasmania. Most of them bear confinement well.

The genus *Platygeucus* is the largest of the family, embracing, according to Reiche-

now, forty-one species, distributed from the Malay Islands over the South Sea Islands to Australia and Tasmania. From the other genera of the family they differ in having the tail feathers of the same size throughout their length, and longer than the wings, the four middle ones unequal and longer than the rest. The feathers of the back are lancet-shaped, and one feature, which is almost characteristic of the genus, is that all the feathers have a dark centre and a lighter margin. The species are gregarious, and, while grass seeds form the bulk of their food, they feed also on flowers and various insects. All are brilliantly colored, and are killed extensively for food by the inhabitants of the regions where they occur. Some are frequently kept as cage-birds, the rosella parrot (*P. eximius*) being an especial favorite. It is active and lively,



FIG. 102. — *Platycercus eximius*, rosella parakeet.

and its colors are so bright that we must take space to describe them. The head and back of the neck are scarlet; below, the chin and neck are white. The feathers of the back are dark green, edged with a beautiful lighter green, and this latter color is also seen in the tail-coverts. The breast is yellow, shading on the belly into green.

A few small parrots with strong bills, which are higher than long, tails shorter than the wings, a cere like that of the last family, or in the shape of a band surmounting the base of the bill, form the family MICROSITTACIDÆ. Their distribution is much like that of the last family, except that Papua seems to be their metropolis. Of their habits but little is known except that their food consists largely of soft fruits, supplemented by insects.

Three genera, *Psittacella*, *Cyclopsittacus*, and *Nasiterna*, represented by eighteen species are recognized, but so little are they known that only the last mentioned has received a common name, — pigmy parrots. In size they are the smallest of the order, and in their coloration green predominates, relieved by blue, scarlet, yellow, and other colors. In *Nasiterna* the tail is rounded and the shafts of the feathers extend beyond the barbs.

The lories form the family TRICHOGLOSSIDÆ, and have about the same distribution as the Micropsittacidae and Platycercidae. The characters of their bill and tongue at



FIG. 163. — *Nasiterna pygmaea*, pigmy parrot.

once separate them from all others. The former is as long as or longer than high, smooth and usually without distinct teeth, while the tip of the tongue is beset with bundles of bristly papillæ (except in the genus *Coryllis*). The cere is broadest on the top of the bill, and runs down on either side to a point. The tail varies in shape with the genus, but is usually shorter than the pointed wings. The lories are quick flyers, and jump about among the branches, but do not climb, as do many of the forms yet to be described. Soft fruits form the bulk of their food, but, as the structure of their tongue would indicate, they are very fond of the nectar of flowers. They form large flocks, sometimes thousands being

found together, when the noise of their loud voices is almost deafening. In all, eighty-eight species are recognized.

The typical genus, *Trichoglossus*, embraces half the family. In size they are between a sparrow and a dove; in their coloration green predominates, and next in order comes red, especially on the breast. The long tails taper to a rounded point, and hence the species are known as the wedge-tailed lories. The species which we figure comes from South Australia, and is known as Swainson's lory. Its back, wings, and tail are green, its head and belly blue, breast red, sides yellow, and the other parts variously mottled with all of these colors. Its favorite habitat is in the gum-trees (*Eucalyptus*) which form so prominent a feature in the vegetation of the country. From the large flowers of these trees it extracts honey, varying its diet with insects. It lays two eggs in the hollows of the highest gum-trees.

Closely allied are the broad-tailed lories belonging to the genus *Domicella*. Their tails are shorter than the wings, and, as the common name indicates, are broad, the

feathers never being pointed at the extremity. Some twenty-two species are known, all from the Austro-Malay region. The prevailing color is red, variously marked and mottled with blue, though occasionally one may be green, brown, or even black.

Passing by the genus *Coriphilus*, with its five species, we come to *Coryllis*, the genus of bat-parrots, characterized by having the tail but about half as long as the pointed wings, and the tongue without the papillæ, noted as characteristic of the family. Indeed, so different are they in habits as well as structure from the other members of the family that their separation, at least as a sub-family, seems warranted. They have not the strong flight of the others, but jump about either when on the earth or



FIG. 161. — *Trichoglossus nova-hollandia*, Swainson's lory.

among the branches. They do not have as varied a voice as the others, but utter only a single note. Most noticeable among them is their mode of rest. When sleeping or even when eating, they hang head downward from the branches of the trees or the bars of their cage. They reach much farther north than the rest of the family, some being found in southern China and Ceylon, but the majority come from the Malays. Many have been carried to Europe, where they form interesting pets. They are readily tamed and become very affectionate. The prevailing color is green. The species figured is the blue-crowned hanging-parakeet of Malacca, Sumatra, and the adjacent islands. Its native food is fruit and berries, but in captivity it thrives on canary seed, especially if this is varied occasionally by ant pupæ or insects.

The PALÆORNITHIDÆ extend farther west than the families so far mentioned, for while some occur in the Austro-Malay region, others are found in India and Africa.

They have a strongly developed beak, higher than long, but without distinct teeth in its margins. In color the beak is usually red, but it may be black or lead color; whatever its color, it always has a waxy appearance, by which these birds can readily be separated from all the other parrots. The small cere extends across the beak, and is as wide at the sides as at the middle; it is frequently partly feathered. The tail may be long and tapering, or broad, straight, and short; the second and third (rarely first and second) wing feathers are the longest. The general coloration is green. In habits the greatest diversity is found, and no general summary will answer for all, as in the families already mentioned.



FIG. 165. — *Coryllis galgulus*, blue-crowned hanging-parakeet.

First to be mentioned is the now extinct Madagascar parrot, *Muscarinus obscurus*. At about the beginning of the present century living specimens were brought to Europe, and yet, to-day, specimens are to be found only in the museums of Paris and Vienna. Its general color was brown, with the head and the base of the tail griseous, the beak red.

Turning now to the living forms, *Palæornis* must be mentioned first. This genus embraces some twenty-two forms of long-tailed parrots which have no bare space near the eye. They inhabit Madagascar and the Oriental regions. They are sociable birds with loud screeching voice. The sexes are distinguished by the different color of the bill, — red in the males, black or yellow in the females.

Apparently one species of this family was known to the ancients. Onesierites, the admiral of Alexander the Great, brought from Ceylon a green parrot with a red ring around its neck. Some have regarded this as the form known to science as *Palæornis eupatrius*, while Linné thought he recognized the ancient form in a species from Java, which he therefore called *P. alexandri*. Now most people think that the common ring-parrot of India, the *Palæornis torquatus*, was the bird brought by Alexander's sailors. Others more or less closely allied were brought to Greece and Rome from



FIG. 166. — *Palæornis torquatus*, ring-parrot.

Africa. These were the only parrots then known, and from their beauty, as well as their docility and powers of speech, they were great favorites.

The ring-parrot occurs both in India and Africa. In the former country it is one of the most abundant of the order, not only in the forests, but even about towns and villages. It forms a pest in some localities on account of its ravages in the fields and gardens. It associates in large flocks, sometimes of thousands, and when these descend on a field of grain, the amount they consume is of considerable account. It has a harsh cry, and learns to repeat a few words, but is not nearly so good a talker as some of the other species.

The species of *Tanygnathus*, from the Malay region, are much like the forms just mentioned in their habits, but they differ from them in their larger bill and smaller tail. *Electus* shares with the Trichoglossidæ the common name lory. Its four species are Malayan; they are not sociable birds, and are most abundant in the denser forests. The racket-tailed parrots (*Prioniturus*) come from the same region. Their colors are largely blue, green, and yellow, while the fact that their two middle tail feathers terminate in broad spatules gives rise to the common name.



FIG. 167. — *Agapornis roseicollis*, red-faced love-bird.

Some of the love-birds are embraced in the genus *Agapornis*. They are very small parrots, with a short rounded tail, and with a plumage of which the prevailing color is green. Their popular name is well applied, for they are most affectionate creatures, not only when in confinement, but in their native wilds, the forests of the Ethiopian region. Usually they are kept in pairs, and the closeness with which they snuggle up to each other bears testimony to their mutual regard. Our figure shows the red-faced love-bird (*A. roseicollis*) from southwestern Africa.

The gray parrots, forming the family PSITTACIDÆ, are few in number, and are confined to Africa and Madagascar. They have a broad cere covering the whole base of the upper bill; there is a naked space around the eye, the upper mandible is rounded and smooth, and its cutting edges are without teeth. The wings are rather long, and the tail, about as long as the wings, is straight or weakly rounded. Their plumage is gray or blackish, and they are without the bright feathers so characteristic of most members of the order, but to compensate they are among the best talkers of



FIG. 168. — *Psittacus erithacus*, jako, gray-parrot.

the group. They fly poorly, but walk about on the ground, or climb with great agility among the branches of the trees. They are very social and live in vast flocks, feeding on the fruits and especially on the grains of the region, sometimes committing serious depredations on the fields of the colonists.

Two genera are recognized, *Coracopsis* and *Psittacus*. The former embraces the Vaza-parrots of Madagascar, species which show many points of resemblance to the extinct Mascarine parrot mentioned on a preceeding page. Of the two species of

Psittacus, *P. erithacus*, the jaco of west and central Africa is best known, but though this species has been common in Europe for three hundred years, almost nothing is known of its habits in its native country. One curious fact deserves mention. In the Gulf of Guinea are two islands, St. Thomas and Prince's, separated by a distance of less than a hundred miles. On the latter the gray parrots are extremely common, "but not a single kite is met with on the island. On the neighboring island of St.



FIG. 169. — *Sittace hyacinthina*, hyacinth macaw.

Thomas there is an abundance of black kites, but not a single parrot, between whom and the kites a constant warfare is waged, so that, should one of the latter get driven over to Prince's Island he is almost immediately set upon by the parrots and slaughtered; and the compliment is returned if a parrot is so unfortunate as to land uninvited on St. Thomas's."

With the largest family of parrots, the COXURIDÆ, we turn our steps to the New World, to which all of the ninety-three known species belong. They have strong bills,

the upper half of which may be either smooth or grooved, its cutting edges being toothed. The cere is large and even in width across the base of the bill, and is either naked or feathered. The tapering and long tail readily separates these birds from the other New World forms, while from the *Platyceceidae* of the eastern hemisphere they may be distinguished by having the two median tail feathers longer than the others.

First in the order comes the genus *Sittace* which embraces the macaws. These are the largest of the parrots, brilliantly plumaged birds but with the colors laid on in utter defiance of human ideas of beauty; shades of red and blue which do not harmonize are placed side by side, while the contrasts between these and the greens and yellows which also occur is far from pleasing. In short, many appear like nightmares of color. They are separable from others of the family by having the orbital region and cheeks naked or clothed with small feathers; and the second and third feathers of the wing long, the first shorter.

Of the eighteen species only two or three can be mentioned. First comes the hyacinth macaw, *S. hyacinthina*, of Brazil which reaches a length of three feet. Its general color is cobalt blue, with yellow chin and orbital region. Of equal size is the great scarlet macaw, *S. coccinea*, but it is more abundant and more widely distributed, extending from Mexico to northern Brazil. The prevailing color is red, but this is varied on wings, tail, and back with blue and yellow. The green macaw, *S. militaris*, with the same distribution as the last, is somewhat smaller, having a total length of about two feet and a half.

The macaws are noisy birds with harsh and unpleasant voices. They do not talk well, and only with difficulty can they be taught a few words. They make their nests in hollow trees, lay but two eggs at a time, and raise two broods in a season. They are far from timorous birds, and the hunters have no difficulty in bagging large numbers of them. Their harsh voices make them unpleasant as pets.

Of the genus *Conurus*, a single species enters the United States, but further south the species are more numerous, some thirty being known, one extending its range to the Strait of Magelhaen. Some are large, others small; the prevailing colors are green. The larger ones are poor talkers, or cannot articulate at all, but some of the smaller species acquire considerable proficiency in this direction. The only species needing mention is the Carolina parakeet, *Conurus carolinensis*.

The Carolina parrot, the only species of the order which enters the territory of the United States, is apparently doomed to early extinction. At the time when Wilson wrote (1811), it extended north to the Ohio and even beyond, while Barton states that in January, 1780, a large flock was observed twenty-five miles north of Albany, N. Y. To-day the distribution is much restricted. They still occur in considerable numbers in Florida and some of the southern states west of the Mississippi river. In color the Carolina parakeet is generally greenish, inclining to yellow below, and with the head and neck yellow, the forehead brick red. Though an inhabitant of our own country, it has not yet been settled whether the adults of both sexes agree in color. Females have been killed with the head and neck green like those of young birds, but it is not known whether this is the color of the adult female or merely characteristic of birds of the second year.

In regard to breeding habits a somewhat similar uncertainty exists. All agree that it makes its nest in hollow trees, and that the oval eggs equally curved at each end are of a uniform dull white, or greenish white, but the nests are so rarely seen by

scientific observers, that our information on other points is extremely deficient. Audubon thinks that several females lay in the same nest, and that each bird only lays two eggs. They feed largely on the cockle-burr (*Xanthium strumarium*), but they also are very fond of cultivated grains. Indeed it is to the fact that their depredations in the fields of the farmer are (or have been) of serious extent that a large part of their persecution is due. This is not the sole cause for their diminution in numbers and range. So-called sportsmen shoot them in large numbers for the mere purpose of

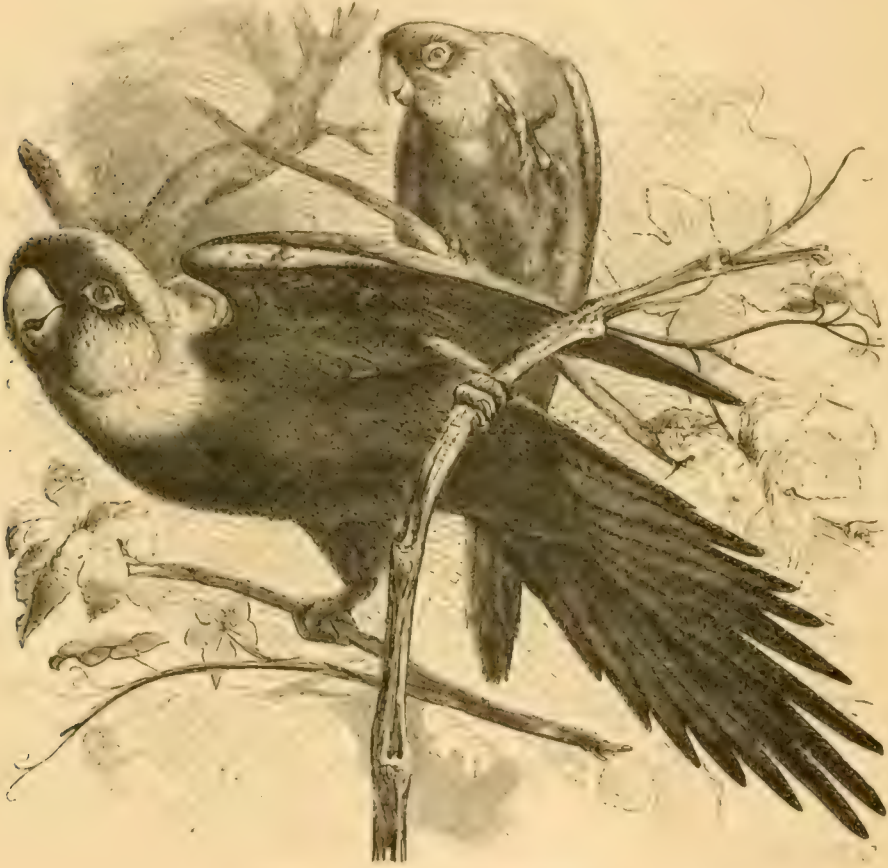


FIG. 170. — *Conurus carolinensis*, Carolina parrot.

killing as many as they can. Professional bird-hunters take hundreds every year in Florida and send them to the north. All these elements are tending toward the destruction of the species.

Nineteen species of *Pyrrhura*, the red-tailed parakeets, are known, all with three exceptions from Brazil, one reaching as far north as Mexico. They are all small. *Brotogeris*, also Brazilian, contains eleven species, while *Bolborhynchus*, with seven species, reaches north to Mexico, and south to the Argentine Republic. One species, the monk or gray-breasted parakeet (*B. monachus*), differs from all other parrots in its nidification. All parrots, with this exception, nest in hollow trees, or in clefts in the rocks. The monk parakeet, on the other hand, builds a free ball-shaped nest, with a lateral

entrance to the small interior. The species of *Psittacula*, seven in number, range from Mexico to northern Brazil. They are small birds, green and blue in coloration.

The **PIONIDÆ**—parrots with short, broad, and straight tails, half as long as the wings; strong bill, with the upper half grooved and toothed near the tip; the cere extending across the base of the bill, produced in front of the nostrils, and naked; and a green coloration prevailing—are found in both tropical America and tropical Africa. At the breeding season they separate into pairs, but at other times they form large, sometimes enormous, flocks. On the ground the larger species are awkward, but the smaller ones are perfectly at home. Their natural voice is harsh, but they are all good talkers, some being excelled in this respect only by the *jako*. Over eighty species are known, seventy belonging to the New World.

Of the genera, *Androglossa* (*Chrysotis*) is the largest and best known. It contains the green parrots known as Amazons. These are distributed over Mexico, the West Indies, and South America. They are so much alike in habits that a description of one will answer pretty well for all. Mr. Gosse, in describing the Jamaican species, says:—

“Flocks varying from half a dozen to twenty or thirty fly hither and thither over the forest, screeching as they go, and all alight together on some tree covered with berries. Here they feast, but with caution. On a slight alarm one screams, and the whole flock is on the wing, vociferous if not musical, and brilliant if not beautiful, particularly when the sun shines on their green backs and crimsoned wings. They generally prefer lofty trees, except when, in June, the ripe yellow plantain tempts them to descend, or when the blackberry shines on the pimento. Of the latter, the flocks devour an immense quantity, and the former they destroy by cutting it to pieces with their powerful beaks, to get at the small seeds. One day in January, when the pimento on the brow of Bluefields Mountain was about ready for picking, being full-sized, but yet green and hard, I observed large flocks of black-bills [*A. agilis*], and a few parakeets flying to and fro with voluble chatter, now alighting to feed on the hot aromatic berry, now flying off and wheeling round to the same neighborhood again. . . . Of two which I shot on this occasion, I found the crop stuffed with the cotyledons of the seed alone, the most pungently aromatic part of the berry; the fleshy part having been, as I presume, shorn off by the beak and rejected. When alighted, as is often the case, on a dry branch, their emerald hue is conspicuous, and affords a fine mark for the gunner; but in a tree of full foliage their color proves an excellent concealment. They seem to be aware of this, and their sagacity prompts them to rely on it for security. Often we hear their voices proceeding from a certain tree, or else have marked the descent of a flock upon it, but on proceeding to the spot, though the eye has not wandered from it, and we are sure that they are there, we cannot discover an individual. We go close to the tree, but all is silent and still as death; we institute a careful survey of every part with the eye, to detect the slightest motion, or the form of a bird, among the leaves, but in vain. We begin to think that they have stolen off unperceived, but, on throwing a stone into the tree, a dozen throats burst forth into cry, and as many green birds rush forth on the wing.”

The species of *Deotypus* and *Caica*, four in number, also belong to tropical America, while the ten of *Porocephalus*, the last of the order, are African.

J. S. KINGSLEY.

ORDER XVII. — PICARIÆ.

Coinciding with Professor Newton's words, that the Picariæ "are already a sufficiently heterogeneous assemblage" to also include the owls, we retained the latter at the end of the Raptores, though admitting that this group, thereby, becomes even more heterogeneous than the Picarians. But, true to our principle of not exchanging one doubtful course for another equally doubtful, we think it safer to adhere to the arrangement adopted. That we have here indicated the true course of development of some of the Picariæ at least, — the goatsuckers and their allies, — seems, however, less doubtful. Another line of descent seems to connect certain forms included in the present order with the Gallinaceous birds, through the Musophagidæ. If this view be correct, then the 'order' Picariæ will have to be split up according to its double descent.

To the scientific ornithologist, the Picariæ form an assemblage of the greatest interest. Their anatomy has in many instances been worked up pretty well, and has disclosed a multitude of characters, generalized as well as specialized, extremely marked, but pointing in all directions. Numerous classificatory attempts have been made, based upon the most different principles, and the most varied sets of characters; still, whether based upon external or internal structure, the general aspects of these different systems show greater similarity than might be expected. Messrs. Garrod and Forbes have especially elucidated the anatomy of the Picarians, and their opinions are, therefore, entitled to special consideration. A brief summary of the more important structural features of the different groups is therefore necessary, the more so since we are obliged to dissent from some of the conclusions of these gentlemen.

Mr. Garrod divided the forms here included into two main divisions, — the Homalognatæ, which possess the ambiens muscle, and the Anomalognatæ, which do not have it. The former, viz. the Cuculidæ and Musophagidæ, he referred simply as families to the 'order' Galliformes, while of the latter, plus the Passeres, he made an 'order' under the above name. This order he again subdivided in Piciformes, Passeriformes, and Cypseliformes. The last mentioned group is generally admitted to be natural and distinct; the other two, and the removal of the Coceygiformes, are rather novel features, and need explanation.

The Cuculidæ and Musophagidæ are zygodactylous, *i. e.*, they have two toes in front and two behind, like the woodpeckers and allied forms, with which they have usually been placed. The structure of the foot is so characteristic that more than the presence of the ambiens muscle would be required to remove them from that neighborhood. Such additional features are also found in the skeleton, as well as in the myology and pterylography. Not to go too deep into details, we shall only refer to the arrangement of the muscles that bend the toes, viz. the deep plantar tendons. In the introduction (page 14), mention is made of the fact that in the Cuculidæ and Musophagidæ the *flexor perforans* splits up to supply second, third, and fourth digits or toes, *i. e.* to the three toes which in most other birds are directed forwards, while the *flexor hallucis* is single, and only goes to the hallux; this arrangement is the original one, as it seems, and the commonest amongst the birds, hence we call it *nomopelmous*; in the cuckoos, parrots, gallinaceous birds, the two tendons are united at their crossing point by a *vinculum*; these are therefore called *desmopelmous*, while the

Passeres may be styled *schizopelmous*, since, being otherwise similar, they differ in having the tendons quite separate; this arrangement is illustrated in Fig. 171A. In Fig. 171C it is quite otherwise; here is a zygodactylous foot, but it is the *fl. perforans* which is single, only supplying the third toe, while the *fl. hallucis* split into three, giving a branch to the second and fourth toes as well as to the first one, or the hallux; being opposed to the above, and only found in these non-cuculine, pair-toed birds, we propose to call this arrangement *antiopelmous*.

While on this subject we may at once describe two other plantar arrangements, which obtain among birds of the present order. The trogons are also 'pair-toed,' or 'yoke-toed,' that is, they have two toes in front and two behind; but while in the woodpeckers the first and fourth are directed backwards, in the trogons the first and second take that position; hence they are said to be heterodactylous. To this entirely unique disposition of the toes corresponds an equally unique distribution of the tendons, for, as shown in Fig. 171D, each of the two flexores splits up into two, the *f. hal-*

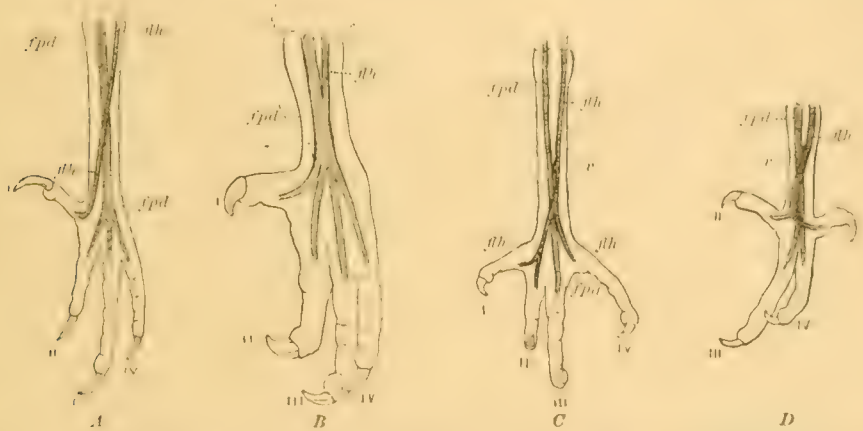


FIG. 171.—Diagrams showing the manner of distribution of the deep plantar tendons; *flh*, flexor longus hallucis; *f. pd*, flexor perforans digitorum; *v*, vinculum. I-IV, first to fourth toes. A, nomipelmous (schizopelmous); B, synpelmous; C, antiopelmous; D, heteropelmous.

lucis supplying first and second digits, *i. e.* the posterior toes, while *f. perforans* bends the two anterior toes, the third and the fourth. This structure, found nowhere else, we shall designate as *heteropelmous*. We have finally to consider Fig. 171B, which represents an arrangement to be called *synpelmous*, since the two tendons are completely blended. It is to be remarked that the direction of the fibres seems to indicate that the *f. hallucis* goes to the fourth toe, while the branch to the first one is supplied from the other tendon, a supposition the more probable since in a slight modification of this arrangement the slip to the first toe (hallux) branches off from the main stem above the point where the two tendons blend together. The *synpelmous* distribution of the deep plantar tendons obtains especially in the swifts, humming-birds, goat-suckers, king-fishers, horn-bills, and their allies, many of which are also syndactylous. We may finally state as an important fact that the synpelmous, the heteropelmous and the antiopelmous arrangements are entirely peculiar to the present order.

Garrod thought that he had another set of characters concomitant with the presence or absence of the ambiens muscle, finding as he did that in all homalognatous birds the dorsal feather tract bifurcates between the shoulder, while in the anomal-

gonatous it is simple until behind the end of the shoulder-blades. A glance at our Figure 172, as compared with Fig. 173, representing the dorsal pterylosis of two anomalognatous birds shows that the bifurcation also occurs among these, as, for instance, in *Steatornis*, *Cuprimulgus*, *Coracias*, etc.,

The swifts and the humming birds have neither cæca nor a tufted oil gland. This combination was at first considered unique in the group called by Garrod Anomalognatæ, since all the rest, including the Passeres, were found to have either the one or the other, hence the Cypseliformes were set apart without further dissent or discussion. Then Garrod found that all of the species examined by him which had cæca were lacking a tuft to the oil gland, and that those which possessed this circle of feathers were deficient in cæca. This discovery led to the division of the non-cypseline Anomalognatæ into two groups, Piciformes with tuft and no cæca, and Passeriformes with cæca but no tuft. As the name indicates, the latter, with several other forms, embraced all the Passeres. As it was found out later on that some of the



FIG. 172. — Pterylosis of *Ramphastos*, dorsal surface.



FIG. 173. — Pterylosis of *Steatornis*, dorsal surface.

Momotidæ, which are destitute of cæca, were also possessed of a nude oil gland, while other species had a minute tuft, resort was had to the theory that the tuft was lost after the two great divisions had branched off, in order to explain this "exception."

We cannot help thinking that too much stress has been laid upon the concomitancy alluded to, and that, by applying it as a divisional character, forms have been artificially separated which are really closely related. With us the concomitancy of the zygodactylous feet with the antiopelמוש plantar arrangement weighs much more, especially since cuckoos and parrots conclusively prove that these two peculiarities are entirely independent of each other. It is extremely improbable that such an abnormal arrangement as is the synpelמוש one should have developed independently in the two groups Piciformes and Passeriformes, while the case of the Momotidæ proves that the absence of the feather tuft on the oil gland is a fact of comparatively slight consequence.

We explained above the two terms, zygodactylous and heterodactylous. Two more will need explanation, viz. misodactylous and pamprodactylous; the former indicates

that three toes are turned forwards, while the latter signifies having all four toes turned in that direction. The reader is now prepared to understand the following attempt at tabulating the chief characters of the Picarian super-families:—

		Homalognonatus; desmopelmous, <i>Cuculoideæ</i>		{ dorsal tract furcate between the shoulders.					
Anomalogonatus	{	X enters the myological formula;	{	synpelmous	{ <i>Coracioideæ</i> ; feet pamprodaetylous	{ dorsal tract simple between the shoulders.			
					<i>Alcedinoideæ</i> ; feet anisodactylous				
				schizopelmous;	<i>Upupoideæ</i> ; dorsal tract furcate between the shoulders.				
				antiopelmous;	<i>Picoideæ</i> ; zygodactylous				
				heteropelmous; <i>Trogonoidæ</i> ; heterodactylous		{ dorsal tract simple between the shoulders.			
		{	A alone constitutes the myological formula;	{	<i>Micropodoidæ</i>	{	pamprodaetylous	{	{ dorsal tract simple between the shoulders.
					or	anisodactylous			

In regard to the above arrangement it may be remarked that *Steatornis* is here included among *Coracioideæ*, but that it is an easy matter to change the scheme so as to accommodate a super-family, *Steatornithoideæ*, should it be thought advisable to adopt such a division.

The Picariæ form a group embracing upwards of eighteen hundred species, highly characteristic of the tropical regions, for while the great majority of the families composing it are “exclusively tropical, none are confined to, or have their chief development in, the temperate regions.” The Neotropical region is richer in peculiar families, but the total number of families represented in the Ethiopian region is greater. In regard to the many curious features of the geographical distribution of the Picariæ, Mr. Wallace remarks: “We may see a reason for the great specialization of this tropical assemblage of birds in the Ethiopical and Neotropical regions, in the fact of the large extent of land on both sides of the equator which these two regions alone possess, and their extreme isolation, either by sea or deserts, from other regions, — an isolation which we know was in both cases much greater in early tertiary times. It is, perhaps, for a similar reason that we here find hardly any trace of the connection between Australia and South America which other groups exhibit; for that connection has most probably been effected by a former communication between the temperate southern extremities of those two continents. The most interesting and suggestive fact is that presented by the distribution of the *Megalaimidæ* and *Trogonidæ* over the tropics of America, Africa, and Asia. In the absence of paleontological evidence as to the former history of the *Megalaimidæ*, we are unable to say positively whether it owes its present distribution to a former closer union between these continents in intertropical latitudes, or to a much greater northern range of the group at the period when a luxuriant sub-tropical vegetation extended far toward the Arctic regions; but the discovery of *Trogon*, in the miocene deposits of the south of France, renders it almost certain that the latter is the true explanation in the case of both these families.”

The super-family CUCULOIDEÆ, being homalognonatus, desmopelmous, and zygodactylous, is to all appearance a natural group composed of two families, the plantain-eaters and the cuckoos. The former are characterized by having tufted oil glands and after-shafts to the contour-feathers, at the same time lacking colicæcæ. The cuckoos, on the other hand, lack tufts and after-shafts, but possess two cæcæ.

In having small heads and a long neck, as also in the character of the plumage and several structural features, the MUSOPHAGIDÆ, or plantain-eaters, resemble the Gallinaceous birds, to which they certainly are not very distantly related. Indeed, the

largest species, *Corythaola cristata*, presents a most striking similarity to a hokko, and is not much inferior in size. The family is strictly African, however, no species occurring outside of the Ethiopian region proper, not even in Madagascar. The true plantain-eaters (*Musophaga*) are glossy bluish or violet-black, and have a bony frontal shield as a prolongation of the beak much in the fashion of the coots. They are large and handsome birds, the typical species of which (*M. violacea*) is figured in the accompanying cut. The turacous (*Turacus*), so called in imitation of their cry, are somewhat smaller, of a peculiar light green color, while the wing-feathers are of a most beautiful carmine; a rounded, strongly compressed feather-crest adorns the head. The most interesting fact in regard to these birds, is, perhaps, the nature of



FIG. 174. — *Musophaga violacea*, violaceous plantain-eater.

the coloring matter. As already mentioned in the introduction (page 5), the only green pigment discovered in birds is that which has been called turacoverdin, while turacin, the magnificent red pigment of the wing, is equally peculiar to these birds. This latter pigment is the more remarkable, since it is said to be washed out during heavy showers of the rainy season, leaving the feathers pinky white, their former beauty being resumed, however, in the course of two or three days. The best known species is the white-crested turaeon (*T. corythair*) from South Africa, which, like its congeners, frequents the highest trees, feeding on fruits. The colonists call them lories. Another South African species is the gray turaeon (*Chizarhis concolor*), similar in form, but uniform gray all over. The following is an abstract of an interesting account communicated to Mr. R. B. Sharpe by Dr. Exter: "In traveling through the Betchuana country, one often comes upon a party of five or six of these

birds, hiding from the mid-day heats under the sheltered portions of dense foliage near the centre of a large tree. Whilst yet undisturbed, the crest lies flat on the head, and can only be seen as a tuft projecting from the occiput. But their first act on becoming aware of an intruder is to run along the branches, either to the summit of the tree, or to the extremity of a branch commanding a good look-out, where, with crest fully erected and well thrown forward, they keep up a constant reiteration of their note. If but little alarmed, they move rapidly from branch to branch, frequently jerking up the crest, and assuming an attitude of attention. Again, after flight from one tree to another, on alighting, they first rest on a branch, with the body somewhat horizontal and the tail drawn nearly to the perpendicular, as if assuring themselves of their equilibrium, and then, raising the body, elongating their neck, and, at the same time, elevating the crest, they seem to take an observation as to the security of their new position. So much is this a habit of the bird, that, during the conversational difficulties of my earlier intercourse with the Betchuanas, when inquiring for the nest of *Chizærhis* (the native name of which is 'Ma-quaa'), as soon as it dawned upon the mind of a native what bird I meant, he has imitated its note, accompanied by a sudden jerking up of the hand, with his fingers extended to the utmost, as if at the same time to mimic the elevation of the crest. I was one day walking along a low ridge of rocks, from which I flushed an owl that flew to some distance to a clump of trees. Presently I heard an agonized scream, such as is made by a young antelope when seized by a dog; and so exact a repetition of the sound was it that even my dogs were deceived by it, and rushed off in the direction whence it came. I also sent a Kafir boy, and presently followed myself, when I discovered it was the frightful scream of *Chizærhis*, of which a party were collected round the owl I had previously disturbed, and whose presence appeared to be the exciting cause. At a later period I had second opportunity of verifying this observation."

During the early part of the year 1885, Mr. F. E. Beddard, the successor of Garrod and Forbes as prosector of the London Zoological Society, published an attempt to classify the CUCULIDÆ, or cuckoos, on anatomical principles, relying solely upon the presence or absence of the accessory femoro-caudal (B), the nature of the syrinx, and the confirmation of the pteryllæ or feather tracts. He has brought out the concomitancy of some interesting characters and has succeeded in arranging the genera investigated in groups corresponding to their geographical distribution. But it seems as if the anatomical systematists are going to repeat the error of their predecessors, the 'skin ornithologists,' in paying attention only to a single set of characters, as a trifling or unessential feature is not worth more when anatomical or internal than when external.

The investigations of Mr. Beddard show that the syrinx of the Cuculidæ appears in three different forms, the bronchial, the tracheo-bronchial, and the pseudo-bronchial syrinx.

While for the general description of the syrinx we refer to the introduction to this volume (page 16), a short explanation of the above terms may find an appropriate place here. In the tracheo-bronchial form, the syrinx is formed at the point where the trachea bifurcates to form the two bronchi, in such a way that the last tracheal rings and first bronchial rings partake in the formation, and the tympaniform membrane reaches the bifurcation. Such a syrinx is represented in Fig. 175. The true bronchial syrinx is paired, and is located farther down, one on each bronchus; the trachea is simply continued in two bronchi, the first rings of which are complete; at some

distance from the bifurcation they are replaced by semi-rings, the ends of which are connected by the tympaniform membrane, which, therefore, is not continuous with any of the tracheal rings. This condition in the cuckoos is similar to that of *Steatornis*, which is figured later on (page 385). The pseudo-bronchial syrinx, as we propose to call it, is somewhat intermediate between the above two. At some distance down the bronchi are the ends of the semi-rings, separated by a rather broad membrane, but the rings between this and the actual bifurcation are not complete, and the narrow space between their ends is filled by a strip of membrane, which connects the tympanum proper with the bifurcation, and the lower tracheal rings which may also be similarly incomplete, as shown in Fig. 176.

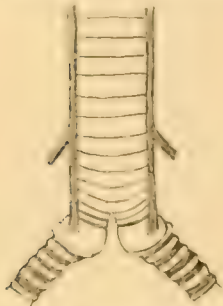


FIG. 175. — SYRINX of *Cuculus*, tracheobronchial.



FIG. 176. — SYRINX of *Cuculus*, bronchial.

ANY+ is concomitant with a certain pattern of the inferior feather tract, as in the cuckoos which have not the muscle B, the ventral tract of both sides is single and not bifurcate. The sub-family thus characterized comprises the true Cuculinae, which again falls in two groups, those of the New World with the inferior space reaching quite to the symphysis of the mandible, an altogether peculiar arrangement, and the Old World species in which it only reaches part up the neck. The pterylographic peculiarities are contrasted in figures 177 and 178. However, on the whole, the classification of the cuckoos is in an unsatisfactory condition, and we therefore proceed to the more interesting forms without committing ourselves to any limitation of the minor groups.

It is but natural to begin with the bird which is *the* cuckoo, from the sonorous voice of which the whole family derives its name. The cuckoo (*Cuculus canorus*), in different local forms occurring all over the Palearctic region, and wandering far south in winter, is astonishingly like, in external appearance, some of the smaller hawks, not only in color, but also in its manner of flight, a resemblance which in Europe caused the superstition that the young cuckoo in the autumn turns into a hawk. The male bird is well represented in the accompanying cut; the back is slaty blue, throat lighter gray, rest of under side white with dusky cross-bars; feet cadmium yellow, and bill dusky, with the corner of the mouth yellow, as is also the eye. Some Oriental cuckoos belonging to the nearly allied genus *Micrococcyx* carry the Accipitrine resemblance still further, as the young birds have the dusky markings on the lower surface longitudinal, as in many hawks and falcons, later on, like them, changing into a plumage transversely barred. This similarity is not accidental, but evidently a case of protective mimicry, a supposition greatly strengthened by the fact that we know of some small Malaccan cuckoos (*Penthoceryx*), rusty brown above, and white beneath, barred with dusky, which, in size, color, and general habits most closely ape the appearance of certain diminutive shrikes inhabiting the same country. Still more remarkable, if

possible, is the mimicry of the Drongo-cuckoo (*Surniculus*) of which more further on. It is, probably, this similarity to a hawk which causes such commotion among the smaller birds when they become aware of the cuckoo's presence, rather than an instinctive recognition of the cuckoo as the parasite which imposes the heavy burden upon them of rearing and educating its gluttonous and ungrateful offspring. We have here arrived at the very vexed questions relative to the reproduction of the cuckoo, of which so much has been written and so little is known. We can certainly do no better than give extracts of the summary which Mr. Seebohm published in 1884 in his excellent work on English birds and their eggs.

"The cause of this curious habit is very difficult to discover. It has been suggested that the hereditary impulse to leave its breeding-grounds so early originally obliged it to abandon the education of its young to strangers; but the same habit is found in many species in India and Africa, which are resident and do not migrate. Others have attributed it to the polygamous habits of the cuckoo, but the cuckoo is not

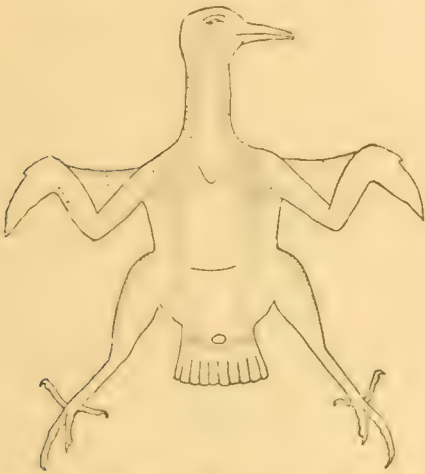


FIG. 177. — Pterylosis of *Piaya cayana*, ventral surface.



FIG. 178. — Pterylosis of *Eudynamis orientalis*, ventral surface.

polygamous, it is polyandrous. The males are much more numerous than the females. The sexes do not pair, even for the season. It is said that each male has its own feeding-grounds, and that each female visits in succession the half dozen males who happen to reside in the neighborhood. A plausible explanation of the peculiar habits of the cuckoo is to be found in the fact that its eggs are laid at intervals of several days, and not, as is usual, on successive days. Very satisfactory evidence has been collected that the cuckoo lays five eggs in a season, and that they are laid at intervals of seven or eight days; but the American cuckoo and many of the owls very often do the same. This power has probably been gradually acquired by the cuckoo, so as to give the female time to find a suitable nest in which to deposit each egg. It is possible that this singular habit of the cuckoo has arisen from its extraordinary voracity. The sexual instincts of the male cuckoo appear to be entirely subordinate to his greed for food. He jealously guards his feeding-grounds, and is prepared to do battle with any other male that invades them, but he seems to be a stranger to sexual jealousy. He is said to be so absorbed in his gluttony that he neglects the females, who are obliged to wander in search of birds of the opposite sex, and appear

to have some difficulty in obtaining the fertilization of their ovaries. The extreme voracity of the young bird is an additional reason why the care of the five nestlings should be entrusted to as many pairs of birds.

"In its choice of a foster-parent for its offspring, it exercises more discrimination than might be supposed from the long lists which have been published of birds in whose nests its eggs have been found. An insectivorous bird is generally chosen, and preference is given to such as build open nests. Sometimes the cuckoo is unable to find the nest of a suitable bird, and is obliged to deposit its egg in the nest of a granivorous bird, such as the various species of finches, buntings, etc., and occasion-



FIG. 179.—*Cuculus canorus*, European cuckoo.

ally cuckoos' eggs have been found in the nests of such totally unsuitable birds as magpies, jays, shrikes, pigeons, and even the little grebe. The young cuckoo is usually much larger than its foster-brothers or sisters, and monopolizes the attention of the parents to the exclusion of the other inhabitants of the nest, who die or are eventually expelled by the young cuckoo. It has been said, on what appears to be incontestable evidence, that the young cuckoo, soon after it is hatched, ejects the young or eggs from the nest by hoisting them on its back; but one feels inclined to class these narratives with the equally well-authenticated stories of ghosts and other apparitions which abound.

"The eggs of the cuckoo are subject to great variation of color, and they very frequently resemble closely the eggs amongst which they have been placed, so much

so that cuckoos' eggs are often supposed to be double-yolked eggs of the same species. This fact has given rise to the extravagant theory that the cuckoo possesses the power of determining the color of her eggs, so as to make them resemble the other eggs in the nest. The explanation, probably, is that the eggs of each individual cuckoo vary very slightly. A cuckoo which lays blue eggs always lays blue eggs, and its descendants will continue to lay blue eggs; it was probably hatched in a nest containing blue eggs, and will, to the best of its ability, intrust the care of its eggs to foster-parents of the same species as those which tended it in its infancy."

The cuckoo feeds on insects, especially caterpillars, being particularly fond of the large hairy ones which most other birds despise, and the walls of the stomach are



FIG. 180. — *Coccyzus glandarius*, great spotted cuckoo.

often found lined with the matted hairs of these larvæ. It is also fond of hairy bumble-bees, but a most extraordinary diet for a cuckoo is certainly the small crustaceans (Gammaridæ) which abound on sandy beaches; still, the present writer was fortunate enough, during a short stay on Copper Island, near Kamtschatka, to shoot a cuckoo which had the stomach crammed with these animals. In justice to the bird, it must be stated, however, that the island had neither hairy caterpillars nor bumble-bees to offer.

Another European species, the great spotted cuckoo (*Coccyzus glandarius*), of which we also present a cut, is confined to the northern and eastern parts. Its breeding habits are likewise parasitic, though somewhat different, as it usually deposits

more than one egg, even as many as four, in a foreign nest, and that it usually selects the nest of some member of the crow family.

Our next figure represents one of the small golden cuckoos peculiar to the African, Oriental, and Australian regions. The species are not larger than a sparrow, and remarkable for the metallic green reflections on the back, and in some species the neck anteriorly also, in richness and brilliancy equalling the radiant hues of humming-birds and trogons. The species figured is the South African golden cuckoo (*Lamprococcyx cupreus*), by the colonists called 'didrie,' in imitation of its voice. It is migratory in the Cape Colony and adjacent countries, and is said to be parasitic in its breeding habits, like most other Old World Cuculinae.



FIG. 181. — *Lamprococcyx cupreus*, golden cuckoo.

The gigantic Australian species and type of a separate genus, the channel-bill, or horn-bill cuckoo of the colonists (*Seythrops nova-hollandiae*) is another form figured. The character of the bill and its whole structure is well represented in the cut; the coloration is similar to that of the European cuckoo, but the orbits and lores are bare and scarlet red. In flight, and in the posture when resting, it is said to be quite hawk-like, and is probably parasitic. Mr. G. Bennett tells of a young bird which was taken alive and placed in an aviary with a 'laughing-jackass' (*Dacelo gigantea*): "Doubtless feeling hungry after its journey, it immediately opened its mouth to be fed; and its wants were readily attended to by the *Dacelo*, who, with great kindness, took a piece of meat, and after sufficiently preparing it by beating it about until it

was in a tender and pappy state, placed it carefully in the gaping mouth of the young *Scythrops*; this feeding process continued until the bird was capable of attending to its own wants, which it now does, feeding in company with the *Dacelo* in the usual manner."

Structurally, the American members of the Cuculinae differ but slightly from their Old World relatives. The former do not exhibit the peculiar parasitic breeding



FIG. 182. — *Scythrops nova-hollandia*, channel-billed cuckoo.

habits, and are, on the contrary, credited with great affection for their mate and for their offspring. Still, some individuals, at least, possess the peculiarity of the eggs ripening only with long intervals, which in the European species is thought to have caused its breeding vagaries. Dr. T. M. Brewer, in speaking of our common yellow-billed cuckoo, remarks as follows:—

"No writer besides Mr. Audubon makes any mention of, or appears to have been aware of, the peculiar habits of these birds in hatching out their successive depositions of eggs, one by one. In this respect they are eccentric, and do not always exhibit

this trait. While I have repeatedly observed facts exactly corresponding with those noticed by Mr. Audubon in the garden of Mr. Rhett, at other times I have found in the opening of the season three or four eggs laid before incubation commenced, and all hatched before others were deposited. Then the parents seemed to depend in no small degree upon the warmth of the bodies of the older offspring to compensate to the younger for their own neglect, as well as for the exposed and insufficient warmth of the nest. I have repeatedly found in a nest three young and two eggs, one of the latter nearly fresh, one with the embryo half developed, while of the young birds, one would be just out of the shell, one half fledged, and one just ready to fly."



FIG. 183. — *Coccyzus americanus*, yellow-billed cuckoo.

We have already mentioned that certain cuckoos closely mimic other birds in their appearance. A most extraordinary case is that of the Indian so-called drongo-cuckoo (*Surniculus dieruroides*), which, as indicated by the names, so exactly imitates the king-crow, or drongo-shrike (*Dierurus*), inhabiting the same locality, in size, form, and color, that there is required considerable attention in order not to confound them, though the arrangement of the toes, of course, at a closer inspection is alone sufficient to separate them. This imitation is the more strange since it has even extended to the curiously fureated tail, a feature elsewhere entirely unexampled among the cuckoos. "Does this cuckoo," asks Dr. Jerdon, "select the nest of the drongo in

which to deposit her eggs? If so, the foster-parents would hardly be undeceived even when the bird has arrived at maturity. One day, in Upper Burmah, I saw a king-crow pursuing what at first I believed to be another of his own species; but a peculiar call that the pursued bird was uttering, and some white in its plumage, which I observed as it passed close to me, led me to suppose that it was a drongo-cuckoo, which had, perhaps, been detected (this being the breeding season) about the nest of the *Dicrurus*. Mr. Blyth relates that he obtained a pure white egg in the same nest with four eggs of *D. macrocerus*, and which, he remarks, may have been that of the drongo-cuckoo."

The tropical regions of the Old World abound in several large, long-tailed, rather high-legged cuckoos, with strong bills, some of which remind us of those of the smaller toucans. They have a muscular formula of ABXY+, and are generally called ground-cuckoos, on account of their habits. Several are said to mimic pheasants in appearance and gait, a similarity which is increased by the large red, naked skin surrounding the eyes of many species, peculiarities which find expression in several of the popular names, as, for instance, crow-pheasant for the common coucal (*Centropus rufipennis*). This latter belongs to a group which is characterized by the straight and lengthened claw of the first toe, resembling much that of a lark, whence they have been called 'lark-heel cuckoos.'

The species constituting the genus *Lepidogrammus*, residing in the Philippine Islands, is remarkable, above all the others, for its rounded crest and the black, horny appendages to the feathers of the head and throat.

Not very distantly related to the Indo-African ground-cuckoos are those of our hemisphere represented by the curious 'road-runner' (*Geococcyx californianus*). From the accompanying illustration it will be seen that this form also has the skin surrounding the eye, and a large space behind it, denuded of feathers. Dr. R. Shufeldt has recently described the color of these naked parts as follows: "In life, the eye of *Geococcyx* is entirely surrounded by a naked area of skin, which both above and anteriorly is colored a deep Prussian-blue tint. Beneath the eye this gradually passes into a pale bluish white, — almost quite white in some lights. The naked space behind the eye is the most extensive of all. Posteriorly this merges into the orange of the parietal skin-tract, while anteriorly it blends with the other color just mentioned." The parietal spaces are described as being "of a deep, though very bright, orange color." We remark, however, that in the colored drawing accompanying the description the spaces mentioned are pure scarlet. The species in question inhabits California, southern Texas, New Mexico, etc., and northern parts of Mexico, in the southern parts of which it is replaced by a nearly allied species, *G. affinis*. The habits are described by Col. A. I. Grayson, as follows: —

"This remarkable bird, which the Mexicans call 'churea, or correa del camino' (road-runner), — so called from the habit it sometimes has of running along a path or road, — seldom fails to attract the attention of the traveler by its solitary and peculiar habits, and often, too, in the mountainous regions and desert countries, where no other living creature is to be seen. Although met with in such localities, it is, however, not entirely confined to them, as it is an equal habitant of some portions of the thinly wooded parts of the *tierra caliente* of the west, where the trees are scrubby and the country open, as the barren and rocky great central plains of Mexico. It seems to prefer a hilly country, but scantily supplied with vegetation, where the numerous species of cacti form impenetrable thorn thickets. Here the road-runner wanders in solitude, subsisting upon grasshoppers, mice, lizards, etc.

"It is most usually met with upon open ground, and, as soon as it discovers the presence of danger, or the intruder, instantly runs off, with remarkable fleetness, to the nearest thicket or hill, where it generally escapes from its pursuers, either by concealment, or a short flight from one hill to another. If a tree with low branches be convenient it will spring into that, and, soon reaching the top, will fly off to the distance of an hundred yards or more. It appears to rise from the level ground with much difficulty. It is very quick in its motions, active, and vigilant; indeed, its fleet-



FIG. 184. — *Geococcyx californianus*, road-runner, chapparal cock.

ness enables it to elude its pursuers, although one may be mounted on a good horse, or a dog may be in the train; but this is only for a short distance, as it could soon be run down by the horse or dog were not some convenient thicket or hill near, from which to take its flight from the latter, or conceal itself among the branches of the former."

Capt. Charles Bendire, in 1872, collected some twenty nests of the 'chapparal cock,' as the road-runner is often called, "the first nest on April 8, the last on September 10. During the month of April, in which I found several nests, not one con-

tained more than three eggs, although I allowed incubation to begin before taking the eggs, as I expected the birds to lay more. Nearly every nest I found after the middle of May contained four or five eggs; and I account for the greater number laid later in the season by the fact that insect food during the dry season, which includes April and May, is comparatively scarce. Only occasionally have I found eggs in different stages of incubation, and I do not believe that there was over a week's difference in the time of laying of the eggs in any nests I found. The food of this species consists chiefly of insects, particularly grasshoppers, but embraces occasionally a lizard or a field mouse. I do not believe they kill and eat rattlesnakes, as has been sometimes reported."



FIG. 185. — *Crotophaga ani*, smooth-billed ani.

Finally, we have to mention the small American family comprising the two genera *Guira* and *Crotophaga*, characterized by having only eight tail-feathers, coincident with a true bronchial syrinx.

Three species compose the latter genus, two of which belong to the North American fauna, as occasional visitors to the southern parts, the smooth-billed ani (*C. ani*) to southern Florida, the groove-billed ani (*C. sulcirostris*) to the valley of the Rio Grande, Texas. Both species are black, with steel blue reflections above, but distinguished by the characters of the bill, as indicated by the names.

We have on a previous page related the vagaries of the Old World cuckoos in depositing their eggs in other birds' nests. The breeding habits of the anis, however, are very different, but not less remarkable or aberrant. Unfortunately, no recent author has had the opportunity of studying the process to such an extent as to fur-

nish us with unquestionable proof of all the details; but, taking all the evidence into consideration, and weighing it carefully, the following seems to be in accordance with facts: The smooth-billed ani, which inhabits the West Indies, often builds its own separate nest, and rears its young separately. But as often, or perhaps oftener, several females unite to build but one nest. In this they all deposit their eggs, which they incubate in common, rearing the young ones together when hatched. Often as many as twenty eggs — blue, with a white chalky covering — are found in one nest, which is said to be a rude collection of twigs and sticks, lined with leaves, large and deep. In many instances the eggs are found in regular layers, with leaves and grass-straw between, and it has been assumed that it was caused by the females covering the eggs while leaving the nest, to preserve them at an equal temperature. It may be, however, that subsequent females continue building the nest after the first ones have deposited the eggs, though it must be conceded that we know nothing definitely at present, and that the breeding habits of the anis is a very promising field for future researches. De Saussure asserts that the anis “breed together in company as well in Mexico as in the Antilles,” referring to the groove-billed species, and, according to Azara, the South American species, *C. major*, has a similar habit, at least in Paraguay. It is very suggestive in regard to the relationship of the piririgua (*Gaira guira*), that the last mentioned author attributes to it the same communistic breeding habits, and that its eggs are covered with a chalky layer similar to that of the ani’s eggs.

To those only superficially acquainted with the external habits of the birds composing the super-family CORACIOIDEÆ, viz., the oil-bird, the podargus, the true goat-suckers, the rollers, and the kirumbo, the statement will be received with some surprise that there has been less doubt in regard to the affinity of the last-named three types, than to whether the first two really belong here. Regarding these, however, the doubt is so great, indeed, that some recent systematists not only make the oil-bird a separate order by itself, but place the podargi and goat-suckers in two different orders. This is chiefly the result of regarding one single character as indicative of relationship. In this case it is the palatal arrangement and the form of the palatine bones which have resulted in the separation of these forms, but it would almost seem as if these characters have comparatively little value in the present order, since we may find a desmognathous and schizognathous arrangement within the same group of birds, the intimate relationship of which cannot be doubted in the least. The different palates are illustrated by the accompanying cuts of the arrangement in the oil-bird, the podargus, and the goat-sucker. In the first-mentioned type (Fig. 186A), the vomer is pointed anteriorly and blended with palatines; the maxillo-palatines are united, and the skull, consequently, desmognathous; the palatines also meet across the median line, presenting a very peculiar feature, each being folded upon itself behind the junction, and lateral posterior processes are absent; basipterygoid facets are present. The podargi have a very different palate (Fig. 186C), the palatines being very broad with large lateral posterior processes and only rudiments of basipterygoid facets. Finally, the goat-suckers proper (Fig. 186B) are distinguished by a palatal arrangement nearly typical passerine, consequently schizognathous, with the vomer truncated anteriorly, but the slender palatines are enormously expanded behind, and small basipterygoid processes are present. Parker calls them ‘incessorial schizognaths.’

Notwithstanding these important differences in the basis of the skull, we regard these three types as related. Indeed, were it not for the palate we should not think

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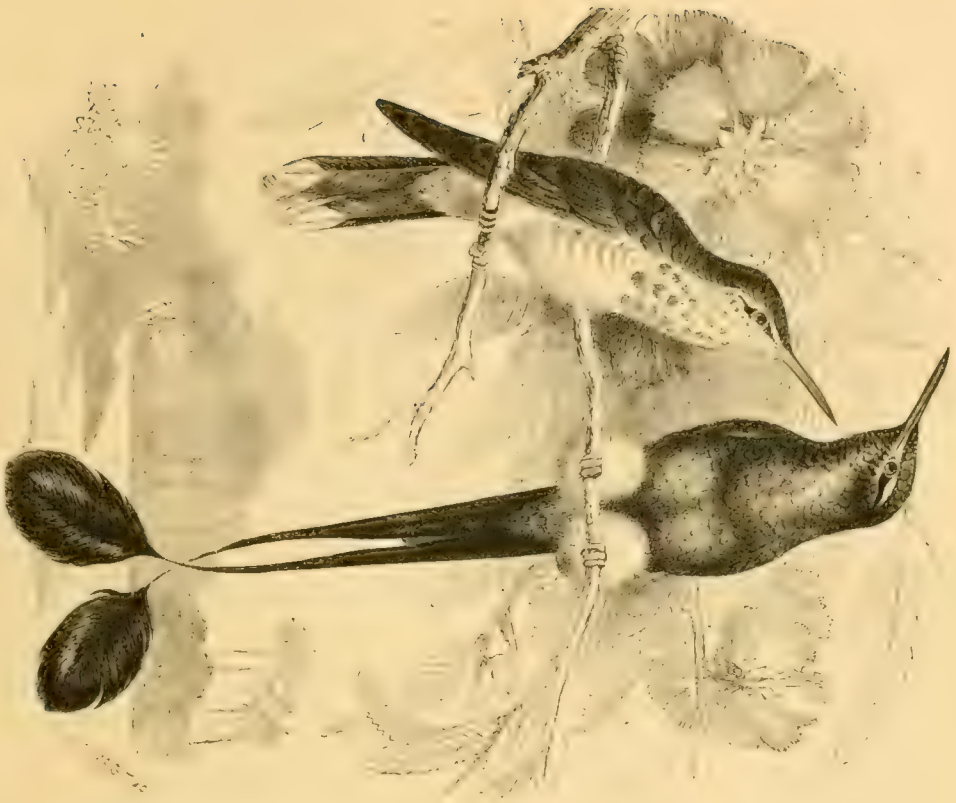


Hirundo rustica, Red-rumped swallow, and *Hirundo ulrichi*, house-martin.



Hirundo rustica, European house-swallow, and *Hirundo ulrichi*, European martin.

Stegana underwoodi, racket-tailed hummer.



Lophornis ornata, coquette.







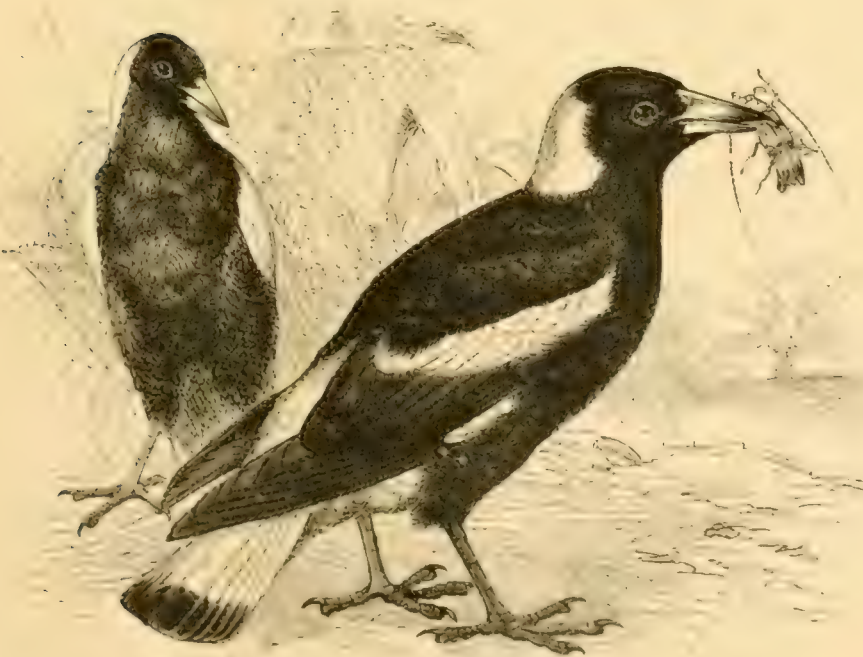
Alcedo ispida, European kingfisher.



Nedegon swinertonii, white-breasted nuthatch.



Garrulus glandarius, common European jay.



Gymnorhina tibicen, piping crow-shrike.



Cephalopterus ornatus, umbrella-bird.



Casmarrhincos nudicollis, naked-throated bell-bird.

of placing the podargi in a family separate from that of the goat-suckers, since with that exception they are very closely approached by the South American *Nyctibius*, which has the palate of a goat-sucker, but in other peculiarities in common with the former, and to be mentioned farther on, disagree with the latter.

The peculiarities of the pterylosis of the present super-family have been indicated and illustrated on a previous page (page 370, fig. 173); hence we only remark that the first three families have only ten tail-feathers, while the last two possess twelve.

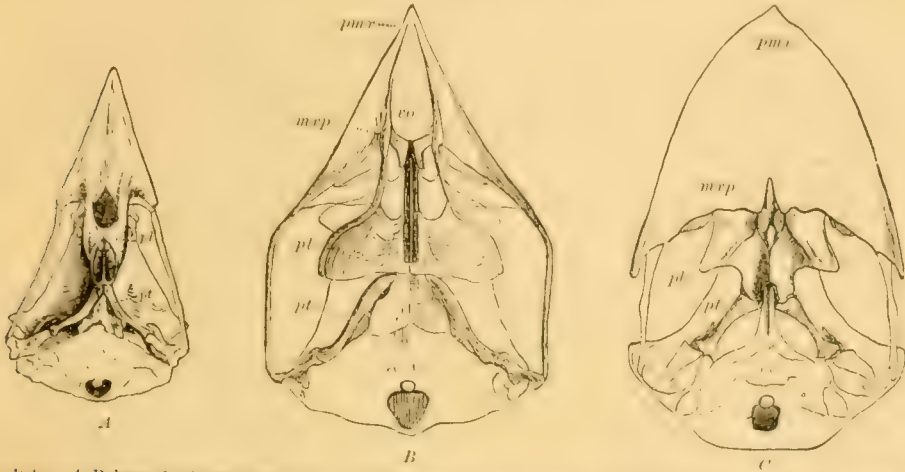


FIG. 186. — A, Palate of oil-bird (*Steatornis*); B, Palate of goat-sucker (*Caprimulgus*); C, Palate of Podargus; mzp, maxillo-palatines; pt, palatines; pt, pterygoids; vo, vomer.

As already intimated, the STEATORNITHIDÆ, which consists only of a single species, the remarkable oil-bird, is possessed of a certain number of structural features which seem to connect this bird with the owls, on one hand, though, on the other, many are so peculiar as to make it somewhat doubtful if Professor Garrod was not right in claiming for it a more independent position. The sternum has only two notches behind; the femoro-caudal is absent; the second pectoral muscle is small; the syrinx is truly bronchial, as depicted in the accompanying figure; the oil gland is very large; and the contour feathers are deprived of an after-shaft. Their bill is also entirely different from that of the other caprimulgoid birds, being much stronger, more owl-like, and with a narrower gape. The color of the plumage, a sombre brownish, dotted with white, and blended with dusky markings, reminds one equally of the goat-suckers and the owls, indicating a bird of nocturnal habits. Altogether it is a bird of a most singular aspect.

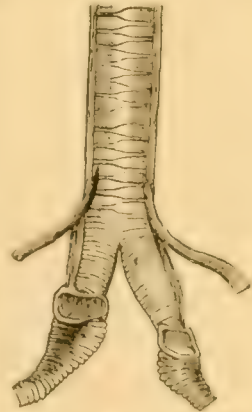


FIG. 187. — SYRINX OF *Steatornis*, front view.

The oil-bird (*Steatornis steatornis*), also called by its South American name *Guacharo*, was originally discovered in 1799 by the celebrated Alexander Humboldt in the caverns near the mission of Caripé (hence it is often called *S. caripensis*), Venezuela. Since then it has been found in several localities in northern South America, lately also in certain districts of Peru, and for some time it has been known to occur in the Island of Trinidad, the fauna of which strictly resembles that of the adjacent mainland, but not

in any of the West Indian islands proper. Mr. W. I. Hornaday, chief taxidermist of the National Museum visited some of the Trinidad caves a few years ago, and has kindly allowed me to make the following abstracts from an unpublished manuscript of his:—

“At the extreme northwestern point of the Island of Trinidad, and directly opposite the extreme northeastern point of the mainland of South America, there lies a group of small islands. The north shore of each of these is a smooth perpendicular wall of rock rising out of deep water to a height of a hundred feet or more. The caves which shelter the guacharo birds are in these cliffs, with their entrance opening only on the blue waters of the Caribbean Sea. When the sea is at all rough, an entrance to any of the caves is utterly impossible, and even in the calmest weather it is necessary to exercise a due amount of caution.

“We set off early one morning when the sea was calmest, pulled westward along the south shore of Monos Island, then out through the Huevos passage into the open sea. Half an hour's pull along the precipitous side of Huevos Island brought us to a tiny bay hemmed in by the same high wall of rock. A turn to the left around some half-sunken rocks and we were at the entrance of the cave, a black, semicircular hole at the base of the cliff, six feet high and twelve wide, into which the swells of the sea dashed every moment.

“The oarsmen held the boat carefully in position until a big wave came rolling in, when they sent the boat flying forward on its crest. We passed safely over the sunken rocks, and the next roller, which lifted the boat so high that we had to crouch down in order that our heads might escape the roof of the tunnel, brought us to terra firma. Scrambling out upon the pebbly beach we found rising before us a huge dome-like cave. The moment we entered there arose a perfect storm of rasping cries coming from the throats of about two hundred guacharo birds that circled about the top of the cave.

“The walls of the cave were smooth bare rock, but at one side a huge mass of fallen rock formed a series of ledges from the floor up to a height of thirty feet. Climbing upon this we found numerous nests of the guacharos. The rocks were covered with guano to a depth of several inches. Whenever a smooth spot offered a safe resting place the nests were placed like so many cheeses, while others were built half swallow-like on the slopes.

“As nearly as we could estimate there were about seventy or eighty nests, nearly all of which we searched for eggs. In different nests we found the number to vary from one up to four, so that we are unable to say what is the usual number laid.

“Half an hour from the time we entered, the surf began to thunder so ominously against the rocks outside, that our guide announced that we must quit the place without delay, or run the risk of being penned up in the cave for an indefinite length of time. Reluctantly enough we tumbled our specimens into the boat and pushed off.”

At the meeting of the Washington Biological Society, when Mr. Hornaday read his paper he also exhibited one of the nests, very characteristically likened by him to a cheese from seven to nine inches in diameter, and from three to six inches in height, with the top slightly hollowed. It was formed of a brownish, spongy mass of considerable solidity, which apparently consisted of the undigested seeds and skins of fruits, ejected by the mouth, and mixed with the droppings of the birds.

This indicates that the guacharo feeds upon fruits, which, in fact, constitute its only food, quite in contradistinction to the other caprimulgoid birds, which are exclu-

sively insectivorous, an interesting analogy to the two groups of frugivorous and insectivorous bats.

The name 'oil-bird' is derived from the superabundance of fat in the young birds, from which the natives prepare a colorless and inodorous oil, extensively used instead of butter.

The characters of the PODARGIDÆ, so far as they relate to the palatal structure, have already been pointed out. There remain to be briefly mentioned a few other peculiarities. Dr. Ph. L. Selater has published the result of the anatomical examination of a *Podargus*, the most important of which are the total absence of the oil gland, and the presence of a pair of large powder-down patches. The latter he describes thus (Fig. 188): "Two large powder-down patches were discovered, placed on each side of the rump. Each patch consists of about forty feathers, placed in a line extending from above the outer end of the root of the rectrices towards the femur. Each feather consists of a horny sheath, about 0.8 inch in length, of which 0.5 is external. At the termination of the sheath the feather presents the usual decomposed appearance of powder-down patches, being divided entirely into numerous elongated minute filaments of a dark gray color."

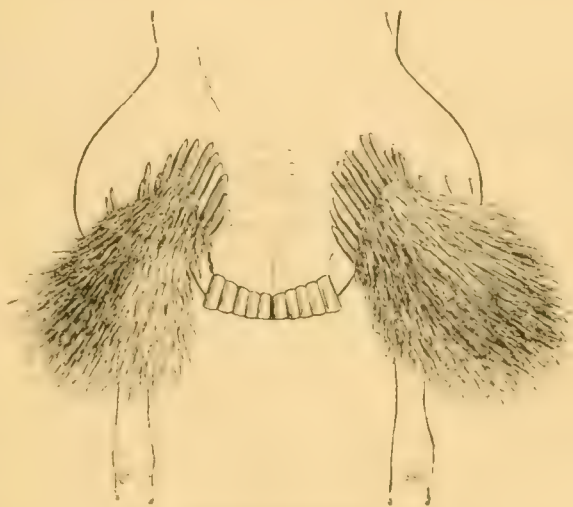


FIG. 188. — Powder-down patches of *Podargus*.

The external aspect of the members of this family is very much like that of owls and goat-suckers, but the bill is most enormously widened, and the size, especially that of the gigantic podargi, is considerably greater than that of the goat-suckers. Their habits, though quite nocturnal, differ considerably from the latter, since their food seems to consist mostly of insects which crawl along the bark of the trees.

The geographical distribution of the Podargidæ is limited to parts of the Oriental and Australian regions, the podargi proper belonging to New Guinea and Australia, while the frog-mouths (*Batrachostomus*) are confined to southern India, Burmah, Malacca, and the Moluccan Islands. A species of the latter genus is figured in the accompanying illustration, but their habits seem to be very little known. An interesting feature is an apparent dichromatism analogous to that of many small owls, some specimens presenting a gray, others a rufous, phase.

The CAPRIMULGIDÆ, goat-suckers or night-jars proper, have a long second pectoral muscle, a small oil gland, and after-shafts to the feathers. They are easily divided into two sub-families: Nyctibiinæ, which have the outer toe consisting of five phalanges, the normal number, a smooth middle claw, and four notches to the hind border of the breastbone, while the Caprimulginae have only four phalanges in the outer toe, the edge of the middle claw pectinated, and the sternum with two notches only. *Nyctibius* agrees with the Podargidæ in most of the features in which it differs from

the other goat-suckers, but the character of the palate seems to refer it to the latter. It is a small group restricted to South America and the Antilles, in aspect and habits very similar to the other *Caprimulgidæ*. A striking peculiarity is the tooth of the bill, as depicted in the accompanying cut.

The *Caprimulginae* form a nearly cosmopolitan group of nocturnal birds, which, like the owls, play a great rôle in the superstitions of all human races, whether white or black, red or yellow. "The harmless, unoffending goat-sucker," says Mr. Waterton, "from the time of Aristotle down to the present day, has been in disgrace with man. Father has handed it down to son, and author to author, that this nocturnal thief subsists by milking the flocks. Poor injured little bird of night, how sadly hast thou suffered, and how foul a stain has inattention to facts put upon thy character! Thou hast never robbed man of any part of his property, nor deprived the kid of a drop of milk.

"When the moon shines bright you may have a fair opportunity of examining the goat-sucker. You will see it close by the cows, goats, and sheep, jumping up every now and then under their bellies. Approach a little nearer. See how the nocturnal flies are tormenting the herd, and with what dexterity he springs up and catches them as fast as they alight on the bellies, legs, and udders of the animals. Were you to dissect him and inspect his stomach, you would find no milk there. It is full of the flies which have been annoying the herd."

The same author, in speaking of the species inhabiting Demerara, and referring to the largest, continues as follows: "Its cry is so remarkable that, having once heard it, you will never forget it. When night reigns over these innumerable wilds, whilst laying in your hammock, you will hear the goat-sucker lamenting like one in distress. A stranger would never conceive it to be the cry of a bird; he would say it was the departing voice of a midnight murdered victim, or the last wailing of Niobe for her poor children before she was turned into stone. Suppose yourself in hopeless sorrow, begin with a high, loud note, and pronounce 'Ha, ha, ha, ha, ha, ha, ha!' each note lower and lower, till the last is scarcely heard, pausing a moment or two betwixt every note, and you will have some idea of the moaning of the largest goat-sucker in Demerara. Four other species of the goat-sucker articulate some words so distinctly that they have received their names from the sentences they utter, and absolutely bewilder the stranger on his arrival in these parts. The most common one sits down close by your door, and flies and alights three or four yards before you as you walk along the road, crying, 'Who are you, who-who-who-are-you.' Another bids you 'Work away, work-work-work-away.' A third cries mournfully, 'Willy-come-go, willy-willy-willy-come-go.' And high up in the country, a fourth tells you to 'Whip-poor-will, whip-whip-whip-poor-will.' You will never persuade the negro to destroy these birds, or get the Indian to let fly his arrows at them. They are birds of omen and reverential dread. If the largest goat-sucker chance to cry near the white man's door, sorrow and grief will soon be inside, and they expect to see the master waste away with a slow consuming sickness. If it be heard close to the negro's or Indian's hut, from that night misfortune sits brooding over it, and they await the event in terrible suspense."

The goat-suckers are of a very uniform appearance, their coloration being a blended mixture of brown, gray, black, buff, and white, and to others than the specialist the characters by which they are separated into genera and species seem trifling and unimportant. Few but the ornithologists will therefore care to hear all

these minute details by which our whip-poor-will or the night-hawk may be distinguished from the more than hundred other forms in the different parts of the globe. The tropics, however, have developed, even in this group, strangely ornamented species, as, for instance, the object of the accompanying cut, the pennant-winged night-jar (*Cosmetornis vexillarius*), and the nearly allied *Macrodipteryx longipennis*, in which the shaft of the elongated primary is denuded except at the extremity, which is broadly webbed for a considerable distance. These singular night-jars are confined to Africa. Hardly less curious are the South American lyre-tailed goat-suckers (*Macropsalis lyra* and allies), with their enormously elongated outer tail-feathers.



FIG. 189. — *Cosmetornis vexillarius*, pennant-winged night-jar.

The whole external habitus of the rollers, CORACIADÆ, reminds one forcibly of certain Passerine birds, with which they were, indeed, associated by earlier ornithologists; but their four-notched breastbone, with a pointed episternal apophysis, symmetrical arrangement of the plantar tendons, rudimentary basipterygoid processes, desmognathous character of the maxillo-palatines, extreme attenuation of the vomer, and furcation of the dorsal tract between the shoulder-blades, at once indicate their position amongst the Picariæ. We have already, on a previous page, indicated an external character by which they may be easily distinguished from the foregoing families, viz., the number of tail-feathers, which is twelve. Besides, their gaudy colors prevent them from ever being confounded with any of the goat-suckers.

The Coraciadæ are characteristic of the Ethiopian and Indian regions, though one species, the common roller (*Coracias garrula*), is extensively distributed over the temperate western portions of the Palearctic region, and a few species of the blue-colored broad-bill rollers (*Eurystomus*) enter parts of the Australian and Austro-Maylayan regions. None of the rollers are found in the New World.

The island of Madagascar possesses three species of rollers, so different *inter se* that they are regarded as types of different genera, and so different from all other rollers that a separate sub-family has been established for their reception. The Brachypteraciadæ, therefore, consist of three genera, *Brachypteracias*, *Atelornis*, and *Geobiastes*, which are not found anywhere else than in Madagascar. They are charac-



FIG. 190. — *Coracias garrula*, roller.

terized by their long tarsus, and their nocturnal, ground-feeding habits, hence they have been called ground-rollers. The *Atelornis pittoides* is gorgeously colored, very much after the fashion of a *Pitta*, and, as remarked by Messrs. Roch and Newton, it is singular that such a brightly colored species should be nocturnal in its habits. Structurally the ground-rollers show relationship to the next family,—the Leptosomatidæ. The accompanying engravings illustrate the two representative genera of the rollers, the European species, *Coracias garrula*, and the Indian, *Eurystomus orientalis*. A cut can only do slight justice to the former's beautiful colors. The general color is a light bluish green, inclining to verditer, the mantle light cinnamon brown, the wings and rump adorned with beautiful azure blue. The name 'roller' is derived from its pecu-

liar flight, which is varied and unsteady, and often the bird turns over in the air like a tumbler pigeon.

The genus *Eurystomus* is remarkable for being represented in Africa by ruddi-colored species, while blue is the predominating coloration of those living in India and further east; but Mr. R. B. Sharpe remarks that from his study of the kingfishers (Alcedinidæ) he is led to consider that the possession of a blue color by one species and of a ruddy tint by another does not indicate remote relationship. "Change," he



FIG. 191. — *Eurystomus orientalis*, broad-billed roller.

says, "the lilac tints into blue all over the body, and the African broad-billed rollers assume the exact style of coloration as their eastern congeners." The broad-billed rollers, like the true rollers, are said to be fond of tumbling in the air.

Lieutenant H. R. Kelham makes the following remarks upon the habits of *E. orientalis*: "I hardly like to say that it is nocturnal in its habits, still it is rarely met with during the heat of the day; but in the country round Kevala Kangsar, Perak, I frequently saw it of an evening when on my way home after a day in the jungle; it

was usually perched on the upper branches of some tree, from which it made short flights into the air in pursuit of insects. The first one I shot was only winged, and, turning on its back, and uttering harsh screams, it fought most savagely with my dog. It was a male; length eleven inches; irides dark brown; legs, feet, and beak, scarlet; plumage greenish blue; head almost black; wings very prettily marked with blue and black, each having on it a spot of very pale blue; patch on throat rich violet; beak short, strong, and hooked at tip; gape and eyes very large."

The following family, the *LEPTOSOMATIDÆ*, is not the least remarkable for the fact that there is only one species living, inhabiting the wonderful Madagascar, while another is known as fossil from the tertiary deposits in France. As may be expected, this last survival stands alone among his more modern contemporaries, and many are, indeed, its peculiarities, though the relationship to the rollers is unmistakable; in fact no other living birds come nearer to it, and several authors refer it unhesitatingly to the *Coraciadæ*. There are two external peculiarities which may be very well seen in the illustration herewith presented, viz., the position of the nostrils at the middle of the beak, the curious development of the loreal plumes into a conspicuous tuft, and the apparently yoke-toed feet. I say apparently yoke-toed, since the fourth toe is not placed directly behind, as in the cuckoos or wood-peckers, but laterally, rather more behind than in front. This disposition of the toes induced the older systematists to place the bird in question among the *Cuculidæ*, but Dr. P. L. Selater has shown that it differs considerably from the latter, and approaches the rollers. Recent studies of its myology show that it really belongs here; the breastbone presents some peculiarities of its own. The pterylosis is remarkable. It possesses long after-shafts, and the dorsal tract bifurcates between the shoulders, and there are two highly developed powder-down patches, one on each side of the rump, as shown in the appended figure. There seems, consequently to be characters enough to warrant its recognition as type of a distinct family.

Our figure of *Leptosomus discolor*, or kirumbo, as it is called by some of the natives of Madagascar, only represents the male, which is glossy green, with coppery reflections on the back and crown, cinereous on sides of head, round the neck, and below. The female, which by Reichenbach was made the type of a different genus, and placed in a different part of the system, is barred and spotted with blackish and rufous brown.

The French traveler, Alfred Grandidier, gives the following account of the habits of the kirumbo. They "live in bands of ten or twelve individuals on the borders of woods. As soon as one of these birds is knocked over with a shot, all the others place themselves at a little distance off or hover round the hunter, so that sometimes one may kill as many as ten in less than a quarter of an hour." About the roller-like tumbling in the air, Messrs. Roch and Newton made the following observations: "It has a peculiar habit of playing in the air for some time over the same place, ascending almost perpendicularly, as it were by a jump, to a great height, and descending again in a curve nearly to the top of the trees, by almost closing its wings, at the same time uttering a whistle so like an eagle's that it was for a long time doubted by us whether the bird that performed this wonderful freak was not a raptorial. However, after having several times watched it with our glasses, we satisfied ourselves that



FIG. 192.—Pterylosis of *Leptosomus*, dorsal view; p, powder-down patches; o, oil gland.

it was this species. Whilst one bird was thus playing, another would frequently answer its cry from a tree hard by."

Only one family constitutes the super-family COLIOIDEÆ, a rank which may fairly be defended by Dr. Murie's words: "If we take one set of regional characters, — the feet, the head, the breastbones, the pelvis, and so on, — we can place it in as many different groups; we can even trace raptorial kin; so that it is hard to say where *Colius* could not be wedged in, and plausibly too. Not only is it entitled to be considered aberrant, but to afford the strongest proof of the interlinking of type, — not in the chain series so often advocated, but, like the Isle of Man tripodal coat-of-arms, kicking its legs about, and whichever alighting upon, there it stands. But if in



FIG. 193. — *Leptosomus discolor*, kirumbo.

true spirit of ornithology we take the bird in its completeness, it will be allowed it does not so closely resemble any acknowledged individual group as to come under its definition."

As demonstrated by Professor Garrod, the palate is desmognathous (cf. the accompanying cut, Fig. 194), and the vomer is not ossified, and consequently lacking as a bone, therein agreeing with *Alcedo*. There are no basipterygoid processes. As to the breastbone, he asserts that it resembles that of the Megalaimidæ more than any other bird. The rostrum is indented, but not deeply cleft. In regard to internal characters, his researches confirm the result of Dr. Murie, based upon osteological grounds, that the Coliidae are not to be referred to the Cuculoidæ, as has usually been done. They lack the ambiens muscle, and "in the arrangement of its plantar

tendons, *Colius*, although so peculiar and uncertain in the manner in which it employs its toes, exactly resembles the feeble-footed Alcedinidæ, and hardly differs from the Coraciadæ, Meropidæ, Bucerotidæ, and Caprimulgidæ. I could find no trace of intestinal cæca. Nitzsch has shown that the oil gland is tufted, and that there are ten rectrices." Only the left carotid is present, and the syrinx is most nearly related to that of *Ceryle* among the kingfishers. Professor Garrod sums up thus: "From what



FIG. 131.—Palate of *Colius*;
m.p., maxillo-palatines;
pl., palatines.

has been said above, it is evident that *Colius* must be included among the Piciformes, and near those of this division with a left carotid only, a four-notched sternum, and a blended plantar-tendon arrangement. No other piciform bird, however, combines these characters. Consequently, the fact that the combination of characters is unique justifies us in retaining the Coliidae in a separate family, related on one hand to the Picidae, and on the other to the Alcedinidæ and Bucerotidæ."

Very interesting is the construction of the foot, which is pampodactylous, that is, all toes turn forwards, even the first one, though it seems as if the latter is reversatile. Dr. Murie compares the foot "to a human hand strongly clawed, which, by a kind of gripping or squeezing of the digits, securely fastens to the slightest inequalities of surface." It seems, however, as

if the colies are able also to direct the fourth toe more or less backwards, thus sometimes grasping thin twigs in a way similar to the yoke-toed birds.

Only one genus, *Colius*, requires recognition. It is strictly confined to the Ethiopian region, except Madagascar, and the southern and eastern portions seem to be the richest in species. There are not many known yet, for in the latest review of this genus (July, 1885), Capt. G. E. Shelley only enumerates eight species, besides three geographical races. He gives the following condensed account of their habits:—

"The colies are all fruit-eaters, live in small bands, frequent thick bushes, and, when disturbed, fly straight to some neighboring covert. Owing to their peculiar structure, they place themselves in the most extraordinary attitudes when they rest or scramble amongst the boughs, and they roost at night in thickly packed companies for warmth, generally, if not always, with their feet above their heads. Their nests are cup-shaped, and placed in thickish bushes at a few feet from the ground, and some, if not all, of the species frequently add green leaves to the interior of their nests during incubation. The eggs are rough, rather obtuse ovals, and generally white.

"There are now examples of three species of this genus living in the Zoological Society's Gardens [London]. They are admirably adapted for cage-birds, being active, bold, and apparently hardy, and the quaintness of their attitudes is interesting to watch."

The species figured is *C. macrourus*, which inhabits northeastern, eastern, and western Africa. Its bill is red at base, black at tip, in strong contrast, feet coral red. The general color is gray, more isabella-colored underneath, and a patch of pure sky-blue on the nape. The '*Muis-vogel*' of the boers in South Africa (*Colius colius*) is distinguished by having the lower and middle back black, with a broad white band down the centre.

In order to show at once which families we intend to include in the super-family ALCEDINOIDEÆ the following table has been prepared:—

Sternum 4-notched	1 carotid; spinal space	<i>Meropidae</i> ; nude oil-gland	} <i>cæca</i> developed
	{ muscular for- mula A X Y	<i>Todidae</i> ; tufted oil-gland	
		sternal notches open	
{	2 carotids; no spinal space	sternal notches converted into foramina	} no <i>cæca</i> .
		<i>Momotidae</i> ; aftershaft	
Sternum, at most, 2-notched	{ muscular for- mula A X	<i>Alcedinidae</i>	} no aftershaft
		<i>Bucerotidae</i>	

We have already mentioned the synpelmous arrangement of the plantar tendons in the present super-family, and it is interesting to remark that, while a similar arrangement is found in some other groups, associated with bifurcation of the spinal feather-



FIG. 195.—*Colius macrourus*, long-tailed colly.

tract between the shoulders, it is combined with a simple tract and a peculiar conformation of the foot in the present division, as all the Alcedinoideæ are syndactylous, that is, have the outer and middle toes firmly united, at least as far as the second joint.

We shall treat of the families nearly in the sequence indicated by the above table, consequently beginning with the Old World MEROPIDÆ, or bee-eaters, the typical species of which is figured in the accompanying cut. These are among the most brightly-colored Picarians, and inhabit especially the Ethiopian and Oriental regions, sending a few species northward to breed in the warmer portions of the Palearctic realm. Their name is derived from the fact that their principal food is bees, wasps, and sim-

ilar insects, which are seized on the wing. In districts with a flourishing bee-culture they become exceedingly injurious, and are therefore eagerly persecuted, the more so since their flesh is palatable, and their gaudy plumage in high demand by both civilized and savage belles for ornament. The bees are mostly swallowed whole, and it is very remarkable that the birds do not seem to be hurt by the sting, the more so since we know instances of many small birds having been killed by swallowing such poisonous insects; and Naumann states that experiments with ducks had a similar fatal end.

The breeding habits of the bee-eaters are peculiar. They nest usually in colonies,



FIG. 196. — *Merops apiaster*, bee-eater.

digging deep tunnels in steep, sandy river-banks. The tunnel, which is often nine to ten feet long, opens into a breeding-chamber, where the bird deposits four or five white eggs on the bare soil. According to Colonel Irby the beak is used for digging the holes, and he asserts that the bills, after the boring, are sometimes worn away to less than half their ordinary length. Of the common European bee-eater (*Merops apiaster*) it is said that when, in winter, it goes to South Africa, it rears there another brood of young ones; but Mr. Seebohm suggests that there exists a South African colony, the breeding range of which is overlapped by the winter range of the northern colony.

Referring to the wood-cut for the form of a typical *Merops*, a fuller impression of the beauty of these birds may be had by comparing it with the following description

of the colors: Lower parts verdigris-blue, and forehead pale whitish-blue; body above chestnut, passing into rufous on the rump; a black stripe through the eye nearly meets another which posteriorly borders the yellow throat.

The Meropinae proper form a group of hardly more than thirty species. *Nyctiornis* and its allies, which have a more arched bill, and elongated plumes on the throat, like the motmot, form a group of still fewer species. The latter differ also somewhat in their habits, being less active, less sociable, and preferring the dense forests, while *Merops* is very partial to the open country.

During the sway of the old theory that the peculiar birds of one hemisphere were represented in the other hemisphere by corresponding forms, the Meropidae were regarded as represented in the New World by the motmots, or MOMOTIDÆ,—a family which is as exclusively American as the bee-eaters are palæogæan. In this case the theory worked tolerably well, for not only is there a certain external resemblance between the two groups, but they are also evidently related, notwithstanding the fact that the former have well-developed cæca, while the latter have lost them. It is difficult to see why the same explanation which has been advanced in order to explain the absence of feather-tufts to the oil gland of several Momotidae, viz., that they were lost after the ancestral stock had split up into two branches,—one with and another without colic cæca,—should not apply just as well to the presence or absence of cæca as compared with the synpelmous and syndactylous arrangement of the toes.

The Momotidæ, like the next family, have the edges of the bill serrated, which has caused them to be united in a common group, called by some authors Serratirostræ. But this character is not exclusive, since there is a genus of kingfishers (*Syma*), in which the tomia are likewise denticulated. In contradistinction to the Todidæ, however, the tail is graduated and elongated, the middle feathers especially so, except in the small species composing the genus *Hylomanes*. The number of tail-feathers varies in the different genera between ten and twelve. The present family is not rich in species, and the centre of its distribution seems to be Central America. The predominant colors are green and rusty, with bluish or beryl-green ornamental plumes.

The habits of these birds have been summed up as follows: "The birds are solitary, or live in pairs, preferring the shady recesses of the forest. They sit motionless on a low branch, often in nooks near rivulets, wherefrom they dart on their prey. Swainson says they catch their prey on the wing, but Kirk avers that they alight to seize it. Ordinarily their food is insects, reptiles, and fruits. In captivity a bold, mistrusting bird, the motmot will then eat bread, raw meat, oranges, watermelons, small birds, mice, lizards, snakes, cockroaches, etc. On pouncing on these latter, they afterwards strike

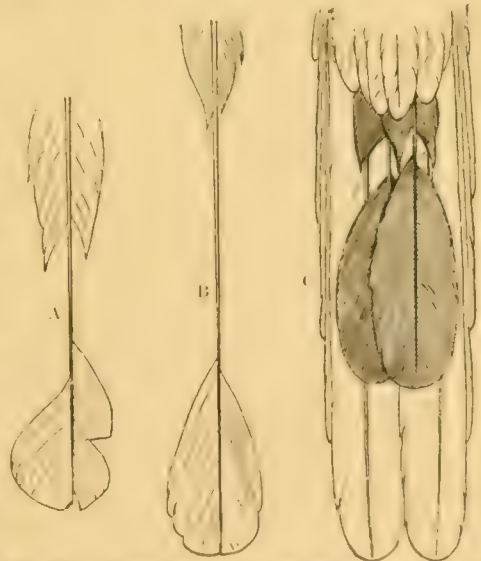


FIG. 157.—Central tail feathers of A. *Myiophobus*, in progress of denudation; B. of *Pseudocolaptes*; and C. of *Momotus lessae* from above, with central feathers half-grown, but yet partially denuded; all half natural size.



FIG. 198.—*Momotus momota*, motmot.

them violently against the ground or perch. Songless, their only cry is 'houtoo.' They breed in holes, and about May lay three or four dusky cream-colored eggs. Sexes undistinguishable; and the young scarcely differ, except in the more downy texture of their feathers. Primaries shed at the first moult. The story has found credence that they nibble off the occasionally absent vanes of the long middle tail-feathers; but this notion has been contradicted."

This sentence, which refers to the racket-shaped tail-feathers of certain species, as illustrated in its perfection by the accompanying figure (Fig. 197*B*), caused an article by Mr. O. Salvin, in which he reproduced a letter from Mr. A. D. Bartlett in regard to a specimen of *Momotus subrufescens*, which for several years lived in the Zoological Society's Gardens in London, to the effect that he had seen the bird in the act of picking off the webs of the central feathers of its tail, and had taken from the bottom of the cage the fragments of web that fell from the bird's bill. Mr. Salvin, in addition, furnished drawings of tail-feathers from skins in his collection illustrating the gradual progress of denudation, from the newly grown feathers with continuous webs to the finished racket. So far as his material goes it seems to corroborate the theory of the bird voluntarily and purposely trimming the feather down. But it will hardly explain the case which is represented in Fig. 197*C*, taken from a specimen in the

U. S. National Museum. The shaded parts indicate the central tail-feathers, the bases of which are still in the sheaths; they are only half grown, and have not yet reached the end of the next pair; still they are perfectly racket-shaped, only that the discs are larger than usual, so that it may be presumed that any future denudation would take place from the nude stem down towards the end of the feather. This point is of some importance, since we find that the denudation of the full grown feather upwards never does proceed farther than the tips of the next pair. Fig. 197A represents a feather which may help to solve the question. In feathers for some reason or other not in prime condition, or part of which are destined by a regularly returning process to fall off, we find by holding them up towards the light, fine transparent lines running across the barbs like strings of minute holes. These so-called 'hunger-marks' indicate where the barbs are going to break. In the figure, drawn from a specimen in the National Museum in Washington, such a line is visible, and the tips of the outer barbs have already broken off. It would not be particularly surprising if the bird subsequently purposely removed the defective barbs, but I see no reason why it may not be assumed, that these already broken barbs may not die entirely off at their insertion, being removed by the serrated beak of the bird when preening its chief ornament. This would account for Mr. Bartlett's having seen the broken barbs falling from the bird's bill. If this be the true solution, then there is no room for the theory that the voluntary trimming through several generations has produced the narrowness of the webs before the discs even in the untrimmed feathers. The species figured (*Momotus momota*) has no disc-like expansion. It lives in tropical South America, and is the oldest known of the group.

Garrod originally referred the Momotidæ to the Passeriformes without tufts to the oil gland and with cæca; but afterwards finding by actual dissection that cæca were absent, and that some species had minute tufts, he removed them to the Piciformes. As to the TODIDÆ of which he seems to have dissected none, he remarks, however, that they almost certainly form a single family with the motmots, adding that he had been able from a skin to determine that they are synpelmous in exactly the same manner as the motmot. Forbes has since ascertained that colic cæca are present, and that simultaneously the oil-gland is strongly tufted. Osteologically Momotidæ and Todidæ are nearly allied, though the latter have no vomer, and their manubrium sterni shows tendency to bifurcation. Here are a few of Dr. Murie's remarks: "It would seem that where outward appearance has swayed, naturalists judged *Todus* as having alliance with the fly-catchers or the motmots; but where anatomical evidence has been relied on, the kingfishers and bee-eaters are the groups with which it carried family likeness. It results from my investigation, and a summing up of the labors of others, that its nearest living allies undoubtedly are the motmots and kingfishers; but it presents such aberrance that it ought not to be ranked amongst either, but in proximity as a separate division—the Todidæ—equivalent to the Momotidæ."

The Todidæ consist only of a single genus of half a dozen forms, which are confined to some of the West Indian Islands. The typical and oldest known species, *Todus todus* (or *T. viridis*), figured in the accompanying cut, shows them to be small (the figure is natural size), somewhat kingfisher-like birds, with syndactyle feet, long and flattened beak with minute serrations along the edge, a short tail, and a plumage which above is bright parrot green, below whitish tinged with faint greenish and yellow, while the throat is of a brilliant poppy red. Mr. P. H. Gosse describes the bill as above horny red, beneath pale crimson. The same author speaks of its habits

as follows: "In all parts of Jamaica that I have visited, the tody is a very common bird. It will allow a person to approach very near, and, if disturbed, alight on another twig a few yards distant. We have often captured specimens with the insect net, and struck them down with a switch, and it is not uncommon for the little boys to creep up behind one, and actually to clap the hand over it as it sits, and thus secure it. It is a general favorite, and has received a favorite name, that of robin redbreast. Commonly it is seen sitting patiently on a twig, with the head drawn in, the beak



FIG. 199. — *Todus todus*, green tody.

pointing upwards, the loose plumage puffed out, when it appears much larger than it is. It certainly has an air of stupidity when thus seen. But this abstraction is more apparent than real; if we watch it, we shall see that the odd-looking gray eyes are glancing hither and thither, and that, ever and anon, the bird sallies out upon a short feeble flight, snaps at something in the air, and returns to his twig to swallow it."

The breeding habits of the todies are interesting inasmuch as they, like the bee-eaters and kingfishers, dig holes in earth-banks of ravines and ditches. Dr. Gundlach,

in Cuba, saw a tody dig with its bill. Two weeks later he found the burrow finished. It consisted of a horizontal tunnel about four inches long, ending in a nest-chamber in which were deposited the pure white eggs.

Like all the other Picarian families, the kingfishers, or *ALCEDINIDÆ*, form a very well circumscribed group, separated from all the others by gaps which future paleontological discoveries may bridge. But now, since the internal structure of all these forms has become better known, it has been possible, with some degree of certainty, to decide upon the mutual relationships. It is interesting in this connection to remark that various authors, looking from different points of view, some from external others from internal characters, came to the same conclusion: viz., that the kingfishers are most nearly allied to the hornbills, in spite of the enormous superficial dissimilarity in structure, habits, and food. We shall return to this point later in connection with the latter family.

When, in 1871, Mr. R. B. Sharpe finished his monograph of the present family, he considered it to consist of one hundred and twenty-five species. Since then, various new species have been described, and altogether we may estimate the number of species to be about one hundred and fifty, concerning the geographical distribution of which Dr. Wallace remarks as follows:—

“The kingfishers are distributed universally, but very unequally, over the globe, and in this respect present some of the most curious anomalies to be found among birds. They have their metropolis in the eastern half of the Malay Archipelago, from Celebes to New Guinea, in which district no less than thirteen out of the nineteen genera occur, eight of them being peculiar; and it is probable that in no other equally varied group of universal distribution is so large a proportion of the generic forms confined to so limited a district. From this centre, kingfishers decrease rapidly in every direction. In Australia itself there are only four genera with thirteen species; the whole Oriental region has only six genera, one being peculiar; the Ethiopian also six genera, but three peculiar; and each of these has less than half the number of species possessed by the Australian region. The Palearctic region possesses only three genera, all derived from the Oriental region; but the most extraordinary deficiency is shown by the usually rich Neotropical region, which possesses but a single genus, common to the larger part of the eastern hemisphere, and the same genus is alone found in the Nearctic region, the only difference being that the former possesses eight, while the latter has but a single species. These facts almost inevitably lead to the conclusion that America long existed without kingfishers; and that in comparatively recent times—perhaps during the miocene or pliocene period—a species of the Old World genus, *Ceryle*, found its way into North America, and, spreading rapidly southward along the great river-valleys, has become differentiated in South America into the few closely allied forms that alone inhabit that vast country—the richest in the world in fresh-water fish, and apparently the best fitted to sustain a varied and numerous body of kingfishers.”

We have in our plate the representatives of the two sub-families into which the kingfishers are divisible, viz., the common European kingfisher (*Alcedo ispida*), type of the *Alcedininae*, characterized by the long scapular feathers forming a kind of mantle covering the back, and the white-headed halcyon (*Halcyon semicrura*), one of the *Halcyoninae*, in which the scapulars are short. To this latter group, which embraces the omnivorous and reptilivorous species, belong the giants of the family, among others the giant kinghunter of Australia. The latter is now so popular a bird

that it deserves a more than passing notice, hence we reprint Mr. H. Wheelwright's graphic account of its habits:—

"About an hour before sunrise the bushman is awakened by the most discordant sounds, as if a troop of fiends were shouting, whooping and laughing around him in one wild chorus. This is the morning song of the 'laughing jackass,' warning his feathered mates that daybreak is at hand. At noon the same wild laugh is heard, and, as the sun sinks into the west, it again rings through the forest. I shall never forget the first night I slept in the open bush in this country. It was in the Black Forest. I awoke about daybreak, after a confused sleep, and for some minutes I could not remember where I was, such were the extraordinary sounds that greeted my ears; the fiendish laugh of the 'jackass,' the clear, flute-like note of the magpie, the hoarse cacks of the wattle-birds, the jargon of flocks of leather-heads, and the screaming of thousands of parrots as they dashed through the forest, all joining chorus, formed one of the most extraordinary concerts I have ever heard, and seemed at the moment to have been got up for the purpose of welcoming the stranger to this land of wonders on that eventful morning. I have heard it hundreds of times since, but never with the same feelings that I listened to it then. The laughing jackass is the bushman's clock, and, being by no means shy, of a companionable nature, a constant attendant about the bush-tent, and a destroyer of snakes, is regarded, like the robin at home, as a sacred bird in the Australian forests. It is an uncouth-looking bird, a huge species of land kingfisher, nearly the size of a crow, of a rich chestnut brown and dirty white color; the wings slightly chequered with light blue, after the manner of the British jay; the tail-feathers long, rather pointed, and barred with brown. It has the foot of a kingfisher; a very formidable, long, pointed beak, and a large mouth; it has also a kind of crest, which it erects when angry or frightened; and this gives it a very ferocious appearance. It is a common bird in all the forests throughout the year; breeds in a hole of a tree, and the eggs are white; generally seen in pairs, and by no means shy.

"Their principal food appears to be small reptiles, grubs, and caterpillars. As I said before, it destroys snakes. I never but once saw them at this game. A pair of 'jackasses' had disabled a carpet-snake under an old gum-tree, and they sat on a dead branch above it, every now and then darting down and pecking it, and by their antics and chattering seemed to consider it a capital joke. I can't say whether they ate the snake. I fancy not; at least, the only reptiles I have ever found in their stomachs have been small lizards."

The racket-tailed kingfishers (*Tanyptera*) belong to the same sub-family. They are peculiar to New Guinea and surrounding islands, and are characterized by having the middle tail-feathers lengthened and racket-shaped, like several of the motmots. It is also to be noted that, like some of the latter, the species of *Tanyptera* have only ten tail-feathers, while nearly all the other kingfishers have twelve. Dr. Wallace, in a letter to Mr. R. B. Sharpe, thus describes their habits: "These birds are all inhabitants of dense thickets or forests, where there is soil free from dense vegetation, from which they can pick up insects, small molluscs, or Crustacea. They rest on branches three to five feet from the ground, and dart down on their prey, often with such force as to stick their bill into the ground, as shown by its being often covered with mud. They are said to nest in deserted white-ants' nests, or in caves or holes in banks. In Aru *T. hylocharis* was often brought me by the native boys alive. They caught them before dawn roosting under ledges of the coralline rocks which border the forest water-streams in those islands."

The true *Halecyons*, on the other hand, have their chief development in the Ethiopian region. Mr. Jules Verreaux writes to Mr. Sharpe about them as follows: "Wood kingfishers (*Halecyones*) generally feed on insects in mimosa trees and dry forests; but when the supply is scanty, they turn their attention to lizards. Should this food also fail, they will frequent the water, and fish like a true *Alcedo*. Sometimes they will hover, as if to inspect the water beneath them, remaining in the air for some time, but not so long as a true kingfisher, and then returning to their perch they will sit for hours, scarcely moving, till a passing fish is secured by an active plunge. A curious fact, also, is that when they are in the bush there are generally seven or eight in close proximity; but when they go to the water they keep separate, each by itself. These kingfishers, when they frequent the water or the seashore, eat Crustacea, or small shell-fish, which they hold *between* their feet, and, breaking the shell by repeated blows of their bill, throw the latter away and devour the animal."

We now come to the true kingfishers (*Alcedininae*), remarkable for their fish-eating habits. Our American species belong to this group, and being in fact congeneric with several Old World forms, present no peculiar features of their own. Many, or in fact most of the Old World members of this family are remarkable for their gorgeous coloration. It is especially the silky azure and bluish-green tints which causes the admiration of all observers, and the common European species (*A. ispida*) forms no exception to the rule, for above, the head, scapulars, and wing-coverts are dark green with light greenish-blue lunules on the former, and similarly colored spots on the last-mentioned part; the centre of the back is shining beryl-blue, and the short tail azure-blue; the under side is deep cinnamon-colored, except the white throat.

A few abstracts from Mr. Seebohm's latest work will give the reader an excellent idea of the habits of the fish-eating kingfishers in general: "Like most birds of brilliant plumage the kingfisher prefers a quiet and secluded haunt. It loves the little trout streams, with wooded and precipitous banks, the still ponds and small lakes, ornamental waters in parks, where it is not molested, and the sides of sluggish rivers, drains, and mill-ponds. Here, in such a haunt, the bird often flits past like an indistinct gleam of bluish light. Fortune may sometimes favor the observer, and the bird may alight on some twig over the stream, its weight causing it to swing gently to and fro. It eagerly scans the shoal of young trout sporting in the pool below, when suddenly it will drop down into the water, and, almost before the spectator is aware of the fact, is back again to its perch with a struggling fish in its beak. A few blows on the branch and its prey is ready for the dexterous movement of the bill, which places it in a position for swallowing. Sometimes the captured fish is adroitly jerked into the air, and caught as it falls. The kingfisher may often be seen to pause in its rapid flight, and hover, like a pigmy kestrel, above the pool ere plunging down.

"The kingfisher lives principally on small fish; but it also eats various kinds of insects, and their larvæ. It also captures shrimps, and has been known to take small crabs. All the indigestible portions of its food are cast up in pellets, most if not all of them in the roosting or breeding place.

"The kingfisher rears its young in a hole, which it generally makes for itself, or less frequently adapts for its purpose one ready made. This hole is made in the banks of the stream it frequents. The kingfisher, in spite of its brilliant dress, is a slatternly bird. It may fairly be called an 'ill-bird,' since it fouls its own nest and its peerless eggs. The kingfisher does not make any more nest than that which the ejected fish-

bones supply. The hole is bored rather slowly, and takes from one to two weeks to complete.

"Few birds are connected with more fables than the kingfisher. The superstition that a dead kingfisher, when suspended by a thread, would turn its beak to that particular point of the compass from which the wind blew, is now fortunately as dead as the kingfishers on whom the experiment was tried. The classical fable that the breeding season of the kingfisher was in midwinter, when the sea remained calm and undisturbed by tempests, is equally as inexplicable, and as profoundly forgotten." But still we speak of 'haleyon days'!

Our North American belted kingfisher (*Ceryle alcyon*) is plainer colored, but much larger and more powerful, so as to enable it to add a mouse now and then to its bill of fare.

Before dismissing the kingfishers we must mention that a few Old World species, belonging to two genera, — *Ceyx* and *Alcyone*, — are only three-toed, having lost the inner (second) toe. Structurally these two genera are very closely allied, but their habits are said to differ, *Alcyone* being a fish-eater, while the small multicoloured *Ceyx* feeds on insects, and loves the dense forest.

We have already on a previous page hinted at the relationship of the BUCEROTIDÆ, or hornbills, to the kingfishers, promising a fuller explanation of this seemingly extraordinary assertion. We may then at first remark, that there is now pretty universal agreement among ornithologists that the hornbills require a position somewhat intermediate between the kingfishers and the hoopoes, — having strong affinities to both, — and that the old arrangements either among the crows, on account of their size and blackish coloration, or next to the toucans on account of the enormous large, light, and cellular bills, are entirely out of question as highly superficial and artificial.

Externally the hornbills and kingfishers agree nearly exactly in the shape of the syndactylous foot, and Nitzsch, on pterylographical grounds, united them with *Upupa* in one group, which he called Lipoglossæ. They agree in having tufted oil glands, and in lacking aftershafts and colic cæca. Hornbills and kingfishers, moreover, are synpelmous, as shown before, and the deep plantar tendons of a hornbill has been figured (Fig. 171B). As to the affinities to the hoopoes we may be allowed to quote Dr. Murie: "Lastly, what in exterior appearance can be more opposed to each other than such a great, unwieldy, horned bird as the rhinoceros hornbill and the graceful hoopoe? Yet patient inquiry leads apace to trace the steps of graduation. Admitting that exuberance of casque, and many other external characteristics of the above-mentioned hornbill, can hardly be reconciled with the idea of family relationship to the hoopoes and Irrisors, it cannot be gainsaid that the Bucerotidæ present extremes. When *Tockus* is reached, size and outward peculiarities dwindle till we have a form in which can be recognized semblance to certain of the Upupidæ. There is still a gap; but the very manifold structural agreements and adaptations thereof to habits, etc., are strong evidence of congruity."

The gap between the two families may some day be filled, however, and a fossil form, found in the tertiary deposits near Paris (*Cryptornis antiquus*), which Laurillard has referred to the kingfishers, but which Milne-Edwards says is a hornbill, while Murie points to certain conformations with the hoopoes, may not have been so very distantly related to the common ancestor of the Lipoglossæ.

As it is, the hornbills form a very sharply defined group with many peculiar features of their own. First is to be noted the extraordinary size and cellular structure

of the bill, with the variously shaped 'horn' or 'casque' at the base of the culmen, though not present in all the species, in some of the small ones being only indicated by a compressed ridge. The distribution of the feather tracts is peculiar, since in the large species there is a tendency to obliterate the spaces altogether, but the feathers are inserted very sparsely, and there are no down feathers on the trunk. The strong hairy eyelashes are another peculiarity, and in having ten tail-feathers only, the hornbills disagree with most of the kingfishers. The skeleton is bulky, but the bones are very light, being, as they are, permeated by air to an unusual degree. The sternum is quite peculiar, being very broad behind with only two shallow incisions. A gall-bladder is present.

The hornbills are not very numerous, but, as Mr. D. G. Elliot remarks, "As they exist at the present day, they exhibit to us probably but a remnant of the great family which once dwelt amid the forests of that mighty eastern continent, of which a large portion is now beneath the waters. So, many gaps exist, not one only we may presume; and the diversified forms that would supply the necessary links to complete an unbroken chain of connected species throughout the family have long since disappeared." This same author, in 1882, when finishing his great monograph of this family, recognized sixty species, the geographical range of which covers parts of three of the zoö-geographical divisions of the globe, viz., the Ethiopian, Oriental, and Australian regions, though in the latter confined to its Austro-Malayan province.

Strange as is the aspect of the hornbills, their manners of life are not less peculiar, and some are even completely unique. Dr. A. R. Wallace writes thus of their flight and manner of feeding: "They have powerful wings; but their heavy bodies oblige them to use much exertion in flight, which is therefore not very rapid, though often extended to considerable distances. They are (in the Indian Archipelago at least) entirely frugivorous; and it is curious to observe how their structure modifies their mode of feeding. They are far too heavy to dart after the fruit, in the manner of the trogons; they cannot even fly quickly from branch to branch, picking a fruit here and there; neither have they strength nor agility enough to venture on the more slender branches, with the pigeons and barbets; but they alight heavily on a branch of considerable thickness, and then, looking cautiously round them, pick off any fruits that may be within their reach, and jerk them down their throats by a motion similar to that used by the toucans, and which has been erroneously described as throwing the fruit up in the air before swallowing it. When they have gathered all within their reach, they move sideways along the branch by short jumps, or rather, a kind of shuffle, and the smaller species even hop across to other branches, when they again gather what is within their reach. When in this way they have progressed as far as the bough will safely carry them, they take a flight to another part of the tree, where they pursue the same course. It thus happens that they soon exhaust all the fruit within their reach, and long after they have left a tree the barbets and *Eurylaimi* find abundance of food on the slender branches and extreme twigs. We see therefore that their very short legs and syndactyle feet remove them completely from the vicinity of the toucans, in which the legs are actively employed in moving about after their food. Their wings, too, are as powerful as those of the toucans are weak; and it is only the great weight of their bodies that prevents them from being capable of rapid and extensive flight. As it is, their strength of wing is shown, too, by the great force with which they beat the air, producing a sound, in the larger species,

which can be distinctly heard a mile off, and is even louder than that made by the flight of the great Muscovy duck."

A curious illustration of the latter fact is afforded by the report of the first visitors to the southern part of New Guinea that they had met a gigantic bird measuring twenty-five feet between the tips of the wings, or sixteen as others said, which made a noise when flying off like a locomotive. Mr. d'Albertis solved the riddle and says: "I have ascertained that it was a *Buceros ruficollis*, which makes a peculiar noise in flying.



FIG. 200. — *Buceros bicornis*, concave-casqued hornbill.

This sound, especially when several birds fly together, resembles the noise of a steam-engine; and I succeeded in convincing two or three discoverers of the great bird, who are now on board the 'Ellangowan,' of the fact."

The breeding habits of the hornbills are entirely unique among birds, and I feel, when I tell the general reader of the male hornbill confining the sitting female during incubation by closing the entrance to the nest hole with clay, only leaving space enough for her bill to receive the food he brings, that I will have to produce the most

trustworthy witnesses in order to be believed. Dr. Livingstone in his 'Missionary Travels in South Africa' relates his experience as follows: "The first time I saw this bird was at Kolobery, where I had gone to the forest for some timber. Standing by a tree, a native looked behind me and exclaimed, 'There is the nest of a korwe.' I saw a slit only about half an inch wide and three or four inches long, in a slight hollow of a tree. Thinking the word korwe denoted some small animal, I waited with interest to see what he would extract. He broke the clay which surrounded the slit, put his arm into the hole, and brought out a tockus, or red-beaked hornbill, which he killed. He informed me that when the female enters her nest she submits to a real confinement. The male plasters up the entrance, leaving only a narrow slit by which to feed his mate, and which exactly suits the form of his beak."

Lieutenant-Colonel S. R. Tickell gives the following extract of his notes written down at the time and place of observation, which relates to the concave-casqued hornbill (*Buceros bicornis*), the 'homrai' of the Nepalese, represented in the accompanying cut:—"On my way back to Moulmein from Moolegit (a celebrated peak in the Tenasserim range), when halting at Kyik, I heard by the merest chance from the Karen villagers that a large hornbill was sitting on its nest in a tree close to the village, and that for several years past the same pair of birds had resorted to that spot for breeding. I lost no time, accordingly, in going to the place next morning, and was shown a hole high up in the trunk of a moderately large straight tree, branchless for about fifty feet from the ground, in which the female, I was told, lay concealed. The hole was covered with a thick layer of mud, all but a small space, through which she could thrust the end of her bill, and so receive food from the male.

"One of the villagers at length ascended with great labor, by means of bamboo-pegs driven into the trunk, and commenced digging out the clay from the hole. While so employed, the female kept uttering her rattling sonorous cries, and the male remained perched on a neighboring tree, sometimes flying to and fro and coming close to us. Of him the natives appeared to entertain great dread, saying he was sure to assault them; and it was with some difficulty I prevented them from shooting him before they continued their attack on the nest. When the hole was enlarged sufficiently, the man who ascended thrust in his arm, but was so soundly bitten by the female, whose cries had become perfectly desperate, that he quickly withdrew, narrowly escaping a tumble from his frail footing. After wrapping his hand in some folds of cloth, he succeeded with some trouble in extracting the bird, a miserable-looking object enough, wasted and dirty. She was handed down and let loose on the ground, where she hopped about, unable to fly, and menacing the bystanders with her bill; and at length ascended a small tree, where she remained, being too stiff to use her wings and join her mate. At the bottom of the hole, nearly three feet from the orifice, was a solitary egg, resting upon mud, fragments of bark, and feathers."

Not less interesting is the account of Mr. C. Horne in regard to the same species as his observation indicates that it is the female herself that undertakes the plastering. The nest was placed in a hole in a sissoo-tree on his lawn, opposite the veranda, so that he could watch every thing through a glass: "On the 29th of April the female went into the hole, and did not again come out. From the time the female went in, the male was most assiduous in feeding her, bringing generally the small peepul-fig. On April 30th I observed the female working hard at closing the orifice with her own ordure. This she must have brought up from the bottom of the hole; and she plastered it right and left with the flat sides of her beak, as with a trowel. I never saw

the male bring anything but food; and I never found any food which had been rejected under the tree, and but very little ordure, which latter had apparently been thrown out by the female when the closing-work was finished. The male bird would alight near, then fly to the hole, holding on to the bark by his claws, and knock with his beak. On this the points of that of the female appeared, and received the fruit, when the male flew off. The hole was at first, perhaps, six inches in height, and three or four wide. When closed up, the opening at the widest part was a little larger than would admit the finger. It should, however, be borne in mind that the bill opened upwards, and thus had three or four inches play. The plastering operation took two or three days, after which the ordure was thrown out."

We might continue with similar testimony from Wallace, Bernstein, and other travelers, but want of space prevents us from quoting more, inasmuch as the above will suffice to give an idea of one of the most extraordinary nesting habits we know of. We do not wonder that the hornbills play a great role in the imagination of the natives, and find it quite natural that the female hornbill is regarded by the Burmese as a model of virtue.

The hornbills vary in size from that of a raven to that of a jay; and there is an endless variation of the casque from a nearly obsolete ridge to the immense upturned horn of the rhinoceros bird. A somewhat more aberrant form is *Rhinoplax vigil*, which has a solid, not cellular, casque, bare neck, and elongated central tail-feathers. It lives in the Malay peninsula, Sumatra, and Borneo.

There seems to be good reasons for regarding the ground-hornbills, three African species, one of which is illustrated in our cut, as constituting a special sub-family. Their casque is hollow, and open in front in the species figured; the tarsi are long and the tail comparatively short. There are also important internal differences from the other hornbills, for, while these have a muscular formula of AXY , the ground hornbills have only XY . The difference in the external structure of the feet and in the myological formula is concomitant with a peculiarity in the movements of these birds, as the tree-hornbills hop with both feet together, while the ground-hornbills (*Bucorvinæ*) walk, placing one foot in front of the other. A unique anatomical feature has been described by Mr. W. Ottley. Some of the tree-hornbills have two carotids, others have one; but *Bucorvus* has no functional carotid at all. The vessels are only represented by two imperforate fibrous chords, and their function is performed by the greatly enlarged representatives of the *comes nervi vagi*. Hence, the origin of the arteries for the supply of the head also differs from the usual arrangement, a superior thyroid artery and a facial artery being both absent. As might be expected, the habits of the ground-hornbills are different from those of their tree-loving relatives. They move with ease over the ground, on which they spend much of their time, feeding upon insects, reptiles, and occasionally small mammals.

Few birds can better illustrate the necessity of taking into account all the characters in determining the place in the system than those composing the present super-family, the *UPUPOIDEÆ*. If we only knew their skin, the posterior part of their breastbone, their deep plantar tendons and carotids, we should most certainly refer the hoopoes to the *Passeres*; but since, also, all the other points of their external and internal anatomy are well known, there is no room for doubt but that they form an isolated group belonging to the *Picarian* order, the nearest allies being probably the hornbills, as already mentioned. Still, as they are yet classed with the larks or with

the creepers and sun-birds by most ornithologists of the old school, a short review of the chief points in both directions may be in order.

The following characters are apparently passerine. The foot with its long hind toe and the scutelli-plantar tarsus resembles more that of a bird of the next order than one belonging to the present, the more so since the arrangement of the deep plantar tendons is schizopelmous, or strictly passerine. The posterior margin of the breast-bone is deeply two-notched, unlike most Picarians, though not unknown in this



FIG. 201. — *Bucorvus abyssinicus*, ground-hornbill.

order. There is but one carotid, a feature also common to several Picarians. On the whole, the characters which seem to be passerine are in the general line of specialization, and do not with necessity indicate that the Passeres have sprung from an Upupoid stem. In other words, it seems more probable to us that the hoopoes are an extreme specialization of the Picarian type rather than a half-finished Passerine. The chief Picarian features are the desmognathous palate, pointed manubrial process of the breast-bone, bifurcation of dorsal tract between the shoulders, tufted oil gland, absence of cæca, syringeal arrangement, besides a number of other characters,

the enumeration of which would involve lengthy explanations, entirely out of place here.

Thus defined the hoopoes form a very small group, since several forms which, on the strength of some external resemblance were placed in their immediate neighborhood, as for instance, *Epinachius* and *Falculia*, had to be left with the Passeres where they truly belong. Formerly the hoopoe-like birds must have been more numerous,



FIG. 202. — *Upupa epops*, hoopoe.

for A. Milne-Edwards has discovered in the tertiary deposits of France remains of several forms, some of which have been referred to *Upupa* proper, while others, as *Limnatornis paludicola* and *Laurillardia longirostris*, are considered as not distantly related.

The present super-family, which is peculiar to the Old World, may be divided in two groups, to be given family rank. In order to be brief we only indicate that the

hoopoes proper have a peculiar erectile crest on the head, a square short tail; that they possess no metallic colors, and that the sternal notches are open; their habits are terrestrial. The wood-hoopoes, as the name indicates, are arboreal, have no crest, a blackish glossy plumage of metallic reflections, and a very long graduated tail; the notches of the breastbone are closed behind so as to form foramina.

The former of these sub-divisions, the URUPIDÆ, is composed of about six species belonging to the genus *Upupa*, the typical species of which is figured in the accompanying wood-cut, which gives a good idea of this striking looking bird; and we have only to imagine the highly-shaded portions of the upper half of the bird, including the



FIG. 203. — *Irrisor erythrorhynchos*, wood-hoopoe.

crest, colored with a rusty buff color, which is paler and somewhat pinkish on the breast, in order to have a picture which will prevent us from ever mistaking a hoopoe, whether met with in nature or in the museum. The hoopoes are confined to the warmer portions of the Old World: but the species figured, *U. exops*, is also found in the southern parts of the Palæarctic region, including Europe. It is a bird of terrestrial habits, feeding on worms and insects, which it extracts from their holes in the earth by means of its long pliable, somewhat snipe-like bill. That such a striking bird has not escaped the fate of playing a great rôle in all sorts of superstition is quite natural, the more so since its voice, from which are derived its different names, is

very remarkable. Mr. Robert Swinhoe has described well the peculiar way in which the hoopoe produces its notes by puffing out the sides of the neck and hammering on the ground at the production of each note, thereby exhausting the air at the end of the series of three, which make up its song. "Before it repeats its call," he continues, "it repeats the puffing of the neck, with a slight gurgling noise. When it is able to strike its bill the sound is the correct 'hoo-hoo-hoo;' but when perched on a rope and only jerking out the song with nods of the head, the notes more resemble the syllables 'hoh-hoh-hoh.' Mr. Darwin makes use of this last fact to show that some birds have instrumental means to produce their music."

Like the true hoopoes, the wood-hoopoes, *IRRISORIDÆ*, are accused of emitting a powerful and offensive smell. They are inhabitants of the forests, where they climb on the trunks of trees much in the manner of woodpeckers. They are described as very noisy and restless birds. The wood-hoopoes are restricted to the tropical and southern parts of the African Continent. The species here figured, *Irrisor erythro-rhynchos*, has coral-red feet and bill.

The three words, homalognathous, antiopelmous, zygodactylous, at once and trenchantly distinguish the *PICOIDÆ* from all the other Picarians; and we cannot help thinking that this super-family is an eminently natural one notwithstanding the many yet unfilled gaps between the separate families composing it. These may be tabulated synoptically as follows:—

Oil gland nude; cæca developed; two carotids . . .		<div style="display: flex; align-items: center;"> <div style="font-size: 3em; margin-right: 10px;">{</div> <div> <i>Bucconidæ</i>; gonys rounded; ventral tract without gular branch. <i>Galbulidæ</i>; gonys angular; ventral tract with an inner gular branch. </div> </div>	
Oil gland tufted; no cæca; 1 carotid	<div style="display: flex; align-items: center;"> <div style="font-size: 3em; margin-right: 10px;">{</div> <div> not saurognathous; manubrial rostrum pointed </div> </div>	vomer truncate	<i>Ramphastidæ</i>
		vomer bifurcate	<i>Megalaimidæ</i>
	saurognathous; manubrial rostrum bifurcate		<div style="display: flex; align-items: center;"> <div style="font-size: 3em; margin-right: 10px;">{</div> <div> <i>Indicatoridæ</i> <i>Picidæ</i> </div> </div>
			<div style="display: flex; align-items: center;"> <div style="font-size: 3em; margin-right: 10px;">{</div> <div> 10 rectrices. 12 rectrices. </div> </div>

It will be seen that the super-family is divisible in two groups: one with nude oil gland and well developed cæca, the other with no cæca, but a tufted oil gland; hence Garrod referred the former to his order *Passeriformes*, the latter being his typical *Piciformes*.

He seems to have been in some doubt, however, concerning the *BUCCONIDÆ*, as to whether they possess cæca or not, having had no specimen of this family for dissection; but I find that Professor Burmeister has noted two long cæca in this family, thus confirming Garrod's supposition. This family has been almost inextricably confused by older authors with the *Megalaimidæ*, from which they are distinguished by many important characters besides those mentioned in the table above. One of these deserves to be treated of a little more in detail since, though being an external one, it is usually overlooked. It deserves our attention the more, as it is a character, the development of which can be traced from the young to the adult plumage, thus affording us a means of telling which condition is generalized and which one specialized.

Professor Sundevall was the first author to draw attention to the difference of the upper wing-coverts in *Passeres* and some *Picarians* as compared with the rest of the birds, showing not only that the large secondary coverts in the former are shorter, not covering more than the basal half of the secondaries, while in the latter more than the half is concealed by them, but also that in the former the small coverts are

much less numerous, forming fewer series than in the latter. He furthermore demonstrated the 'perverse' situation of the middle coverts in the Passeres. But even more interesting is his observation that the young birds in the first plumage show more or less trace of the more common arrangement, thus enabling us to decide that the latter is the generalized stage, while the 'oscinine' arrangement is a specialization of it. The oscinine or non-oscinine arrangement of the wing-coverts, therefore, cannot be expected to be always trenchantly differentiated, and intermediate forms may occur, which he has termed sub-oscinine, and in fact our present super-family presents all three stages. The Bucconidæ have non-oscinine wing-coverts, these being larger



FIG. 204. — *Lypornix torquata*, double-banded puff-bird.

and numerous; in the Gallulidæ they are smaller and fewer, but not so much reduced as in the Oscines, consequently sub-oscinine; while in Ramphastidæ, Megalaimidæ, etc., they are quite oscinine in size and number.

The Bucconidæ, or puff-birds, as they are called from their loose and puffy plumage, are also otherwise distinguishable from the Megalaimidæ, or barbets, by having twelve tail-feathers, while the latter have only ten, and by their dull and sombre coloration, as compared with the many and gaudy colors of the barbets. Some of the puff-birds (the genus *Monasa*) are nearly uniform blackish slate, while others are of a mottled rusty and dusky, with whitish markings, as, for instance, in the species here illustrated, the double-banded puff-bird (*Lypornix torquata*). They are small birds, the largest species hardly so large as a robin, with a rather short, conical

and slightly arched bill, which in several species has the end of the upper mandible decidedly hooked. Their food consists of insects, and travelers describe them as dull and stupid birds which inhabit the densest forests. They are said to deposit two white eggs in a deep hole dug into the sandy bank of a ravine or a river. There are known about half a hundred species of puff-birds, which exclusively inhabit tropical America as far north as Guatemala.

Closely allied to the foregoing family are the jacamars, *GALBULIDÆ*, of similar geographical distribution, though entirely confined to the regions east of the Andes. A very characteristic and entirely unique feature of their pterylosis is the inner branch which is given off from the inferior tract at the lower end of its gular portion,

as represented in Fig. 205. Their bill is long, usually straight and angular both above and below; their feet are very short and feeble, and the anterior toes are united for a considerable distance, giving the feet the appearance of a kind of zygodactylous kingfisher's foot. The plumage is characterized by brilliant metallic reflections on the upper surface of the body.

The jacamars are of the same dull and stupid nature as the puff-birds, and are therefore called by the Brazilians 'João doido,' or 'foolish John,' and altogether their habits are quite similar. Thus, for instance, they build in holes in sandy banks, and lay two white eggs. Hardly two dozen species are known, most of them agreeing in shape and colors more or less with the type, *Galbula galbula*. The upper side and breast are of a most brilliant metallic golden green, like that of trogons or humming-birds; hence it is also called in South America 'Bejaflor grande.' The throat is whitish, rest of under surface rusty. *Jacamacrops grandis* is the largest of the group, somewhat similarly colored, but with a shorter, though broader and stouter, curved bill. *Jacamacropyon tridactylus* is notable for having lost the first toe, like the three-toed woodpeckers, thus differing considerably from the three-toed kingfishers, in which it is the second digit that has become rudimentary. The

FIG. 205. — Ventral pterylosis of *Galbula*.

species of the genus *Urogalba* are blackish with steel-blue reflections, and have the two central tail-feathers greatly elongated.

Every well-defined 'family' has its peculiarity which deserves a rather detailed treatment; and the *RAMPHASTIDÆ*, or toucans, form no exception. The first thing which strikes the observer, when looking at one of the large toucans, is the enormous size of the bill. It is not only as long as the bird itself, but it does not lack much of equalling the body in bulk; and the observer will most likely make the remark that such an enormous bill must be very heavy. The fact is, however, that the bill is extremely light in comparison with its size, being very thin, and filled with a light, cellular bony tissue. Professor Owen, in his observations on the anatomy of *Ramphastos*, thus describes the bill: "The osseous portions of the mandibles of the toucan are disposed in a manner adapted to combine with the great bulk of those parts a due degree of strength and remarkable lightness; and the bony structure is consequently of a most beautiful and delicate kind. The external parietes are extremely thin,

especially in the upper beak; they are elastic, and yield in a slight degree to moderate pressure, but present considerable resistance if a force is applied for the purpose of crushing the beak. At the points of the mandibles the outer walls are nearly a line in thickness; at other parts, in the upper beak, they are much thinner, varying from one-thirtieth to one-fiftieth part of an inch, and in the lower beak are from one-twentieth to one-thirtieth of an inch in thickness. On making a longitudinal section of the upper mandible, its base is seen to be a conical cavity. The walls of this cone consist of a most beautiful osseous network, intercepting irregular angular spaces varying in diameter from half a line to two lines. From the parietes of this cone, a network of bony fibres is continued to the outer parietes of the mandible, the fibres which immediately support the latter being almost invariably implanted at right angles to the part in which they are inserted. The whole of the mandible anterior to the cone is occupied with a similar network. The air is admitted to the interior of the upper mandible from a cavity situated anterior to the orbit. The nasal cavity has no communication with the interior of the mandible."



FIG. 206.—Vertical longitudinal section of the bill of *Ramphastos toco*, to show the cellular structure of the bill. *b*, cavity at the base; *d*, external nares; *i*, cerebrum; *k*, cerebellum; *l*, tongue; *m*, orifice of larynx, *n* of pharynx; *r*, beginning of spinal cord; *s*, nasal septum; *tr*, trachea; *u*, air cell, anterior to orbit from which the air enters the maxilla.

To facilitate the understanding of the above, we have introduced Fig. 206, in which is also shown the long and peculiar tongue of these birds, which, looked at from above, presents the appearance of a feather, the margin on both sides being obliquely notched, and the notches toward the extremity becoming deeper and closer together, so as to occasion a bristled appearance of the edges. There are many other peculiarities; but we only mention the fact that the clavicles do not unite at the lower end into a furculum, each one being separately connected with the sternum.

The toucans have a remarkable habit of turning their tails upon their backs. This is performed with a jerk, "as if on a hinge that was operated on by a spring." In examining the caudal vertebræ, it will be found that the six basal ones are articulated by ball-and-socket joints and connected with the last ones, which are ankylosed, by a synovial joint, and can be bent dorsad till their superior spines touch the sacrum, while the broad and large transverse processes almost wholly prevent lateral motion. The muscles, therefore, which in other birds turn the tail sideways, in the toucans become assistants to the true elevators of the tail; for when the latter have bent it upwards sufficiently, the former become dorsad of the centre of motion, causing the

jerk of the tail by suddenly combining with the elevator muscles. The peculiar structure of the tail is also manifested by its unusual elongation, as is evident from an inspection of Fig. 172 (p. 370).

The toucans are confined to the warmer portions of the Neotropical region, and do not occur in the West Indies. They are equally characteristic of the tropical parts of America as are the two foregoing families, and have no near relatives among the Old World birds, though their enormous large and serrated bills offer an analogy



FIG. 207. — *Pteroglossus wiedii*, Maximilian's araçari.

to the hornbills, with which they are often confounded in the popular mind. There are a little more than fifty species, varying in size from that of a robin to that of a crow, the smaller forms having proportionately smaller bills than the larger ones. The former are usually more or less greenish, with brown and yellow; while the latter have the greater part of the plumage black, relieved by the gorgeous coloration of the foreneck, upper and under tail-coverts in red, yellow, and white. The naked eye-space and the huge bill are also painted most vividly and characteristically. The araçaris

(*Pteroglossus*) are intermediate in size and coloration. Thus, the species figured, *P. wiedii*, has a black head and neck, mantle green, under surface yellow, with the rump and a broad band across the lower breast beautiful red. The bill is pale buff and black. This species inhabits Brazil, and is replaced in the regions to the north of that empire with a closely allied form, *P. aracari*. Our next illustration represents the type of the restricted genus *Ramphastos*, the toco toucan (*R. picatus*), the giant of the family. It is black, foreneck and rump white, under tailcoverts red, bill



FIG. 208. — *Ramphastos picatus*, toco toucan.

orange and black, feet blue. Restricted to the slopes of the Andes is a small genus, called *Andigena*, of half a dozen species, characterized by a uniform wash of color on the under surface, instead of the bars of rich red and black so conspicuous in the true *Pteroglossi*. The most remarkable species is *A. laminirostris*, the laminated hill-toucan, the native habitat of which is the forests at the base of Pichincha, a high mountain of Ecuador. Upper side of head and neck are black, back golden brown, rump pale sulphur yellow, under surface ashy blue with a yellow patch on the flanks, under tail-coverts blood-red. Most curious and unique is the laminated appendage of

the bill. On either side of the upper mandible, immediately in front of the blood-red basal band, is a buff-colored plate or lamina, continuous with the structure of the bill at its base, but separate and detached in front, thin on its upper edge, but thicker and projecting beyond the edge of the mandible below.

We will not tax the patience of the reader further by enumerating the names of the various species, preferring to introduce some notes on their habits by travelers who have watched these beautiful and interesting birds in their native haunts. The following is from Edward's 'Voyage up the Amazon':—

"Most noticeable of all these birds, both for size and peculiarity of form, are the toucans. There are many varieties at different seasons, but the red-billed (*R. erythrorhynchus*) and the ariel (*R. ariel*) are the largest and most abundant, seen at every season, but towards autumn particularly, in vast numbers throughout the forest. Their large beaks give them a very awkward appearance, more especially when flying; yet, in the trees, they use them with as much apparent ease as though they were, to our eyes, of a more convenient form. Alighted on a tree, one usually acts the part of sentinel, uttering constantly the loud cry *tucano*, whence they derive their name. The others disperse over the branches in search of fruit.

"We had been told that these birds were in the habit of tossing up their food to a considerable distance, and catching it as it fell; but, as far as we could observe, they merely threw back the head, allowing the fruit to fall down the throat. We saw, at different times, tamed toucans, and they were never seen to toss their food, although almost invariably throwing back the head. The habit is rendered necessary by the length of the bill and the stiffness of the tongue, which prevent their eating as do other birds. All the time when feeding a hoarse chattering is kept up, and at intervals they unite with the noisy sentry, and scream a concert that may be heard a mile. Having appeased their appetites, they fly towards the deeper forest, and quietly doze away the noon. Often in the very early morning a few of them may be seen sitting silently upon the branches of some dead tree, apparently awaiting the coming sunlight before starting for their feeding-trees. When roosting, they have a habit of elevating their tails over their backs."

Azara reports that the toco "builds in the holes of trees, and hatches two young ones, closely resembling the adults, which feed them until they are able to fly."

Toucans are easily kept in captivity, and become very tame, making most interesting pets. They are now rather common in the zoological gardens, where their singular aspects and glorious colors are among the greatest attractions. In captivity they are completely omnivorous, and some authorities assert that they are equally so in the wild state, but the bulk of evidence goes to show that in their native forests they feed chiefly on fruit.

Though usually confounded with the puff-birds by earlier writers, and during the first days of ornithology even united with them in the same genus, the MEGALAIMIDÆ, or barbets, are only distantly related to them, approaching, in fact, in such a way the toucans and the woodpeckers, that their position in the linear system between these two families seems to be indisputable. The characters separating them from the puff-birds have already been given, and their chief distinctions from the families mentioned are apparent from the table heading the super-family.

Both in the texture of the feathers and in the arrangement of the feather-tracts, the barbets agree well with the toucans, and, except in the bill, their anatomy is not very different. It may be mentioned especially that also in the barbets the two clavi-

cles remain separate, not anchylosing into a single furculum. Their bills are small compared with those of the toucans, but are stout, somewhat conic, broad at the base, and more or less compressed towards the tip. In some of the larger species the bill shows some tendency towards the toucans, in being large and serrated along the edges. The tongue is usually long and thin, but simple, though in some large species it is slightly barbed. The name barbet is derived from the large and strong bristles which in most forms are inserted at the base of the bill, and often are so long as to reach considerably beyond the tip. They are, on the whole, small birds, ranging in size from



FIG. 209. — *Megalaima hemacephala*, crimson-breasted barbet.

that of a flicker to that of a sparrow. They are of a rather stout and clumsy build, with big heads, and few of them present any graceful appearance. The coloration is in most cases very gorgeous, but the juxtaposition of the colors is often such as to produce a tasteless effect. Sky-blue, light green, and yellow are sometimes found combined with red and other colors in such a manner as to annoy an eye accustomed to harmony in colors.

The geographical distribution of the barbets has given rise to much speculation. They inhabit the tropical forest zone of both hemispheres, though wanting entirely in Australia. They are represented most poorly in the Neotropical region, notwithstand-

ing their relationship to the toucans, while in Asia and Africa together there are nearly six times as many species as in South America, the number of species known amounting to some eighty. Miocene remains of barbets have not yet been identified, but little doubt is entertained but that the explanation of the curious distribution of the barbets is the same as that of the trogons (p. 371).

The species figured in the accompanying cut is the crimson-breasted barbet (*Megalaima haemacephala*) from the Philippine Islands, but represented by closely allied races all over the Indian region. It is green above, yellowish beneath, streaked with green; forehead and a pectoral gorget glistening crimson, the latter edged behind with golden yellow; throat and eye-region pale sulphur yellow; rest of head black, except occiput, which, together with the sides of the neck, has a bluish tinge. This form is representative of the central and most numerous group of the family. In India it is known as the *tambagut*, or 'coppersmith,' a name originating in its cry, which is a monotonous and deliberate *took, took, took*, accompanied by a peculiar nodding of the head at each call. *M. rafflesii*, from the Malay peninsula, is still more gaudily colored, and deserves mentioning, being one of the commonest species in collections from the tropical east. Mr. R. Swinhoe writes as follows of the habits of *M. faber*, from the Island of Hainan: "From its loud, peculiar call, the Hainan species has earned among the natives of the island the appellation of 'ironsmith,' whence I have derived its specific name. It is a stupid, heavy species, keeping much to the upper boughs of umbrageous trees, especially those of the fig group, of which there are a good many kinds in Hainan. It sits still among the leaves, munching the figs, and you may be under a tree a long time without knowing that a party of barbets are overhead, except from the constant falling of berries. In flying, they hold the head with the heavy bill well up, the body and tail inclining downward, while the wings keep on a continued fluttering, and propel the bird in a straight direction."

The pearl-spotted barbet (*Trachyphonus margaritatus*) from northeastern Africa represents another style of coloration, being umber brown with white spots above; sulphur yellow underneath; upper and under tail-coverts, deep scarlet. The species of this group are also characterized by longer tail and tarsus. Their habits have been described by the celebrated traveler and ornithologist Theodor von Heuglin as follows:—

"The note of the *Trachyphoni* is loud and very melodious; they run (though in a different manner from woodpeckers) up and down the trunks of trees, feeding upon insects, berries, and fruits, as they hop from branch to branch. Their flight is short, but rapid; their course consisting of a series of numerous undulations. I never saw any of the species of this group on the ground. I am not acquainted with the mode of propagation of these birds, except that *T. margaritatus* builds in holes of trees, and lays white eggs, usually from four to six in number." Another African form is *Pogonorrhynchus dubius*, the bearded barbet, with a large, deeply sulcated and dented beak, guarded underneath by long and strong bristles, and with a large naked space round the eyes. Its coloration is very peculiar, in some respects reminding one of some species of toucans, being glossy black above, across the breast, and underneath behind the legs. The throat and sides of neck, together with the middle part of the abdomen, are glossy deep blood-red; flanks, white.

Nearly all the South American species belong to the genus *Capito*, and resemble in their general aspect the true *Megalaimas*, but have the bristles at the base of the bill much less developed. Peculiar are the two species forming the genus *Tetragon-*

ops, since they seem to exhibit characters, both in structure and coloration, which make them nearly intermediate between the barbets proper and the toucans. One feature of their bill is quite unique, however, the lower mandible being distinctly bifurcated at its extremity, and the point of the upper fitting into the groove thus made. On each side the point of the lower mandible overlaps that of the upper one, and, seen in profile, the bill, from either side, reminds one of that of the cross-bill. In coloration the two species are very different. *T. ramphastinus*, from Ecuador, is golden brown above, orange red underneath, with ashy throat, and a scarlet breast-band, head with a small medial crest, and neck above black, with a white postocular streak; while *T. frantzii*, from Costa Rica, is more uniform olivaceous and ochraceous, but in both cases is a certain similarity to the style of the toucan genus *Andigena* not to be mistaken. The first mentioned species is the largest, or one of the largest, of the family.

That we place the INDICATORIDÆ, or honey-guides, near the barbets and the woodpeckers no longer needs special defence; but as many authors still persist in keeping them among the Cuculidæ, a few words on their diagnostic structures may be in order. As shown in the accompanying cut (fig. 210), the palate is schizognathous, and the vomer is bifurcated in front; the dorsal tract is simple between the shoulders; the ambiens muscle is absent; the oil-gland is tufted and the cæca are absent; the deep plantar tendons are antiopelmous; only one carotid is present; "the tensor patagii brevis muscle of the wing is inserted into the extensor metacarpi radialis longus, exactly as in the Megalaimidæ, Ramphastidæ, and Picidæ, and as in no other birds." In all these respects and many more the honey-guides differ from the cuckoos, but agree, on the other hand, with one or more of the families just mentioned. The above suffices to prove their near relationship, and Garrod even went so far as to include the toucans, barbets, and honey-guides as sub-families in the same family. The latter present several peculiarities, however, among which may be mentioned that the number of primaries is only nine. The tail has twelve rectrices, the outer pair being small, as in the woodpeckers.



FIG. 210. — Palate of *Indicator*; max, maxillo-palatines; pl, palatines; v, vomer.

The Indicatoridæ form a small family of about a dozen species, three-fourths of which inhabit the African continent, while the remainder are found in the Oriental region; viz., one, *Indicator xanthonotus*, in India, *malayanus* in Malacca, and *archipelagicus* in Borneo. They are small birds, of rather dull colors—the African species illustrated in our cut (*I. indicator*) being brownish gray, lighter underneath, with white ear-tufts, and a small yellow patch on the inner minute wing-coverts; tail, brown and white.

The names honey-guide and indicator bestowed upon these birds refer to a peculiarity in their habits, so astonishing that it was generally believed to be a fable, until the unanimous statements of trustworthy observers seem to have put it beyond doubt. One of the latest accounts is found in Mr. E. F. Sandeman's 'Eight Months in an Ox-Wagon,' in which he graphically relates his experience with this curious bird, in 1878, in Transvaal, as follows:—

"A small gray bird with a reddish beak, the size of a sparrow, had flown alongside and round the wagon for the last mile of our trek, making a shrill, hissing cry, and sometimes almost flying in the faces of the drivers; and I noticed that the boys

were regarding it with peculiar attention, and talking among themselves in reference to it. On asking what caused the unusual interest of the boys in, to all appearance, a very commonplace bird, it was explained that this little insignificant visitor was the far-famed honey-bird. As soon as the oxen were outspanned and the boys at liberty, three of them, armed with buckets, spades and hatchets, set off towards the bird, which had flown to a neighboring tree as soon as it perceived that our attention was successfully attracted. A. and myself, to whom it was as strange an adventure as it was novel, accompanied the boys. As soon as we reached the tree the little fellow had perched on, it flitted to the next, and then on again when we came up. For



FIG. 211. — *Indicator indicator*, honey-guide.

nearly a mile this was kept up, and as the way grew more difficult and the bushes more dense, our own faith in the bird was rapidly giving place to irritation at what began to look very like a trick of the others at the expense of our inexperience. However, the boys seemed so genuinely astonished at our doubts, that we still followed on.

“At last the bird stopped altogether in a small clump of some dozen mimosa-trees, all growing within a few feet of one another. When we came up to it, instead of, as heretofore, flying off in a straight line, it just flitted on to an opposite tree, remained there a few moments, and then back to its previous position. This was its signal that the nest was close at hand. The boys examined the trunks of the trees round most carefully, but could find no opening where the nest could by any possibility be situated. The bird grew more and more angry and indignant at what it evidently con-

sidered our extreme stupidity, and flapped its little wings and redoubled the shrill cries which it had ceased to utter while leading us to the spot. At last, losing all patience, it actually settled on a piece of the stem of one of the trees it had been persistently flitting backwards and forwards in front of. The boys, now paying more attention to this particular tree, perceived just above where the bird had perched a small hole, and round it a kind of cement. While we were watching, a bee flew out, which made it certain that the nest was within the trunk. The driver of Woodward's wagon, who was an old hand at the work, at once climbed up the tree with a hatchet, and under his direction the others collected armfuls of dried grass. Taking a large handful of this, he lighted it, and then struck with the hatchet at the mouth of the narrow hole. At the first blow a quantity of mud, wax, and decayed wood fell to the ground, with which the bees had skilfully walled up a large portion of the decayed wood. Out swarmed a cloud of bees, and now his burning grass came into operation. As quickly as they flew out their wings were singed in the flames, and they dropped helpless to the ground. A. and myself had retreated to a safe distance from the tree; but the boys stood close up, hardly caring if they were stung or not. In a very few minutes, all the occupants of the nest were destroyed; but new comers were constantly arriving, which made close quarters anything but pleasant. Not much cutting was necessary to lay bare a large portion of the combs, which were laid horizontally across the entire width of the hollow portion of the tree.

"Before leaving we carefully fixed a comb filled with honey on the nearest bush, and our late guide flew down and commenced his well-earned repast as soon as we had turned our backs on the spot. The Kafirs would much prefer not to take any honey at all, than depart with their spoil and not leave a portion for the bird. They firmly believe that if they thus defraud the bird of its just rights, it will follow them up, and at a future time, instead of leading them to honey, will entice them into the lair of a lion, or to a nest in which some deadly snake lies concealed."

The honey-guides lay white eggs, and it is stated, of some of the species at least, that they are parasitic, like the cuckoos.

"Considering the method adopted by the woodpeckers for obtaining their food, it is hardly surprising that they possess cranial features peculiar to themselves; for it is scarcely conceivable that the head, the most delicately constructed portion of the body, should be employed as a powerful hammer or axe, whose strokes can be heard at a considerable distance, without some modifications in structure which would assist in increasing its efficacy for the purpose."

To these words of Professor Garrod, as an introduction to the family PICIDÆ, we wish to append certain statements of Professor W. K. Parker, the result of his studies of the embryological development of the 'saurognathous' palate. Huxley had already characterized the palate of the woodpeckers, or *Celeomorphæ*, according to his nomenclature, as "exhibiting rather a degradation and simplification of the ægithognathous structure." This Professor Parker corroborates from an embryological standpoint, saying: "The view there expressed, that these birds have a passerine foundation, but that they are somewhat abortively developed, arrested one way and wonderfully specialized in another, will be seen to be the exact truth of the matter. The fact is, they are like early embryos of the *Passerinae*, in their palatal region arrested at a most simple and lacertian stage, whilst in other respects they are metamorphosed and specialized beyond any other kind of birds."

The above quotations supplement each other in a manner which affords us the

clew to the peculiarities of the present family. The special use of the bill as a hammer prevented its specialization in the same direction as in the ægithognathous birds.

Parker has briefly stated the chief saurognathous character to be "the want of fusion of the parts of the palate at the mid line." This is especially the case with the vomer, the two halves of which remain separate even in the adult state. They will be seen as two thin styles along the inner margins of the palatines. The abortive development of the maxillo-palatines is also very notable. Another feature is the feeble development of the posterior part of the palatines, the external posterior angle being usually absent. These peculiarities are well shown in Fig. 212 A and B, which, besides, demonstrates the great general resemblance of the woodpecker's palate and that of the wryneck.

There are other features in the organization of the woodpecker which indicate an approach to the Passeres besides the palate, for, as we have already remarked, the manubrial process of the breastbone is bifurcate, and the pterylosis is quite 'oseinine,' the wing-coverts being small and few. Another character of the wing, which is isomorphic with the corresponding one in the more specialized Passeres, is the reduction in size of the first (or, as would be more correct to say, the tenth) primary.

It would take more space than has been allotted to the present family were we to describe in detail all the structural peculiarities of the group, and, consequently, we are forced to content ourselves with mentioning the curious machinery of the tongue.

The woodpecker's tongue consists of the same bones as in most other birds, except that the urohyal is entirely absent. The ceratohyals are only slightly developed, and early fused together. On the other hand, the basihyal and both pieces of the horns (thyrohyals) are unusually slender and extremely elongated, often so long that their ends reach forward over the top of the skull nearly to the tip of the bill, in which case the whole apparatus slides forward in the sheath encasing the bones and their muscles, when the tongue is thrust forward; or the ends of the horns are fastened to the upper side of the skull, and their curvature hangs down along the sides of the neck, as seen in the diagrams, Fig. 213 A and B. The extensor muscles which are attached to the concave curvature of the horns and to the mandible, when contracted, force the tongue forward a distance corresponding to the flattening of the loop of the horns. By this means the cylindrical and worm-like tongue, which at the end is provided with a pointed horny tip and barbed with sharp bristles, can be shot out far beyond the tip of the bill, its flexibility enabling it to penetrate the winding tunnels of the boring insects or the corridors of the industrious ants, on which most wood-

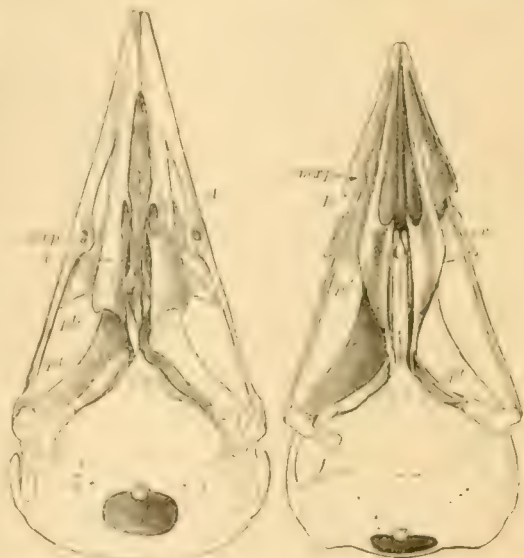


FIG. 212. — Palate of (A) *Dryobates* and (B) *Junco*; mrp, maxillo-palatines; pt, palatines; pt, pterygoids; v, vomer.

peckers feed. Large salivary glands (also indicated in the diagram) serve for lubricating the sliding tongue, and it has been demonstrated that the shortening of the extensor muscles simultaneously exerts the necessary pressure upon the glands.

The woodpeckers form a very isolated group of at least three hundred and fifty species, the geographical distribution of which is very interesting. They are most numerous in South America and the Oriental region, less abundant in Africa, the Palearctic, and North America. It is a very significant fact that they are entirely absent from Madagascar and the whole Australian region, except in Celebes and Flores, both of which were, probably, never connected with the Papu-Australian mainland, and which are situated so close to the Indo-Malayan islands that it is safe to conclude that their woodpeckers are comparatively recent immigrations from the latter.

We recognize three sub-families, the most generalized of which is that of the Picumninae, a not numerous group of soft-tailed woodpeckers from the tropical zones

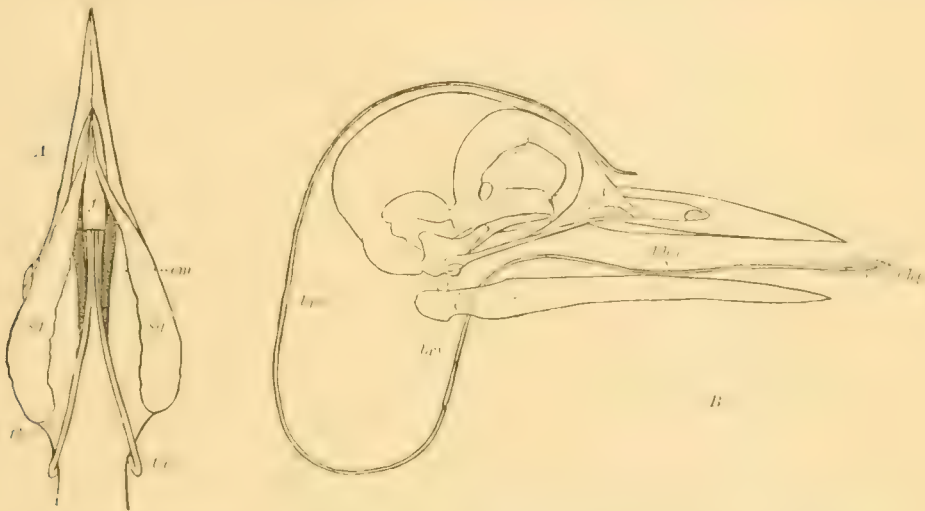


FIG. 213.—Diagrams showing (A) the extensile tongue of *Picus* from below; *em*, extensor muscles; *f*, base of tongue; *sg*, salivary glands; *th*, thyrohyals; and (B) the tongue bones of *Picus* from the side; *ch*, ceratohyal; *bh*, basihyal; *br*¹ and *br*², thyrohyals.

of both hemispheres. Parker regards their palate as the "most embryonic and least specialized," comparing it with that of the rhynchosaurian lizards and the passerine Cotingidæ. The inner edges of the hind part of the palatines are greatly expanded posteriorly and bent over so as to form two post-palatal flanges, as in the Cotingidæ and allies, as well as in the lyre-bird (*Menura*). Of *Picumnus*, Professor Parker finally says: "Altogether, this small, far-western type is extremely instructive, and helps to lead the imagination down to extinct types in which the characters of the hemipod, the *Ior* passerine, and the woodpecker were existent in one generalized form,—a form and a type only a step or two above the raft-breasted ostrich tribe."

The great antiquity of the piculets, as the Picumninae are sometimes called, is also indicated by their geographical distribution. South America possesses by far the greater number of species, perhaps a score; four or five belong to the Oriental region, and one, *Verreauxia africana*, hails from western Africa.

Externally these birds differ from the other woodpeckers chiefly in their diminutive size, and the structure of the tail, which is short and composed of normal, that is,

not stiffened and acuminate, rectrices. A good idea of the habitus of the piculets may be formed from the accompanying plate, which represents, in natural size, *Picumnus lepidotus* from Guiana. It is brownish gray on the back and abdomen, the rest of the under surface being whitish, squamulated with dusky; nasal tufts whitish; head above black, in the male with red anteriorly, and white pearl spots on the posterior half, while the female lacks the red, the spots dotting the whole head above; the tail is black and white. The East Indian genus, *Sasia*, comprises a few three-toed species, the first toe being aborted. In the same region is also found a four-toed form, *Tivia innominata*, which is nearer allied to the Neotropical species.

The habits of these pygmy woodpeckers are very little known. Burmeister says that their habits are entirely similar to those of our kinglets (*Regulus*). Reinhardt, on the other hand, asserts that they differ in no way from the other woodpeckers; that, like these, they hammer on the trees with their bills, and climb on the trunks and even on the under side of the branches, notwithstanding their soft tails. Probably their habits are most like those of the nuthatches, with which they also agree in size. Euler states that they breed in holes in trees, which they bore themselves, and from two to four glossy white eggs have been found in the nests.

The Picinæ, or woodpeckers proper, are easily distinguished by their stiffened, elastic, pointed, and graduated tail-feathers, which are used as a support in climbing, their ends being pressed against the bark, preventing a slipping backwards. The bill is angular and wedge-shaped, forming a powerful hammer or axe, with which to cut off chips of bark or wood in search of insects, or to dig holes into the wood in order to build nesting-holes.

The woodpeckers are usually solitary birds, that is, they do not often associate with others of their own kind. Some of the smaller species, however, seem to be fond of the society of nuthatches, chickadees, kinglets, etc., during their rambles through the woods in autumn and winter. During the breeding season some species are known to produce a remarkable whirring sound, the so-called 'drumming,' by rapidly striking a dry branch, which can be heard to a great distance. This seems to be the male's love-song.

The flight of the woodpeckers is generally powerful, but undulating if kept up for some distance. During their search for food, they proceed through the forests from trunk to trunk, ascending them by starts from the lower part until they reach the top, whence, in a single curve, they descend to the base of the next one. They lay their glossy white eggs in some hole dug by themselves in a more or less decayed tree, and both sexes attend to the incubation. The young ones are more or less like the adults in color, though in many of the most familiar species they are even more highly ornamented than their parents. Thus in most of our species of the genus *Dryobates*, the young ones have the whole top of the head red, while in the adult male it usually becomes restricted to the occiput, and disappears altogether in the adult female. In this case the difference in the two sexes can hardly be attributed to 'sexual selection,' for it seems most probable that the original stock from which these species have developed originally had a red head, and the disappearance of this color may therefore be regarded as protective. That it in most cases has also been partly lost by the male is no objection, since he is known to partake in the incubation.

The Picinæ form a very homogeneous group, the structural characters being only slightly varied, and such extravagant ornaments as racket-tails, wattles, excrescences in form of horns, etc., are entirely unknown. The only sort of ornamental plumes are

the highly-developed nuchal crests in many tropical species. A noteworthy structural specialization in several forms, otherwise not intimately related, is the abortion of the first toe, so that only one hind toe remains — the fourth. Nevertheless, there are several pretty well defined groups, or super-genera, under which the numerous species may be advantageously classified.

Most woodpeckers have the nostrils concealed by tufts of bristly feathers directed forward. In many museum specimens from the tropics these may have disappeared, as the putrefaction which in those countries rapidly sets in first affects the feathers around the bill. But a small group of species, about equally numerous in the tropical



FIG. 214. — *Picus viridis*, green woodpecker, yaffle.

regions of both hemispheres, have no bristles where the bill joins the forehead, and the nostrils are consequently fully exposed. Noteworthy among these forms is the South American genus *Celeus*, the members of which have a very long occipital crest. Some of the Indian species have only three toes, for instance the genus *Tiga*. The absence or presence of the nasal bristles seems, however, to be of little account, since *Nesocleus fernandinae*, which is confined to the island of Cuba, has the nostrils entirely nude, though apparently closely related to the following group.

Our flicker (*Colaptes auratus*) and its many allies belong to another group, which are distinguished by having a less typical wedge-shaped woodpecker bill, the angles being more rounded, and the whole bill slightly arched. In regard to the remarkable

polychroic state of the yellow-shafted flicker and the red-shafted species, we refer to the introduction to this volume (p. 8), where this question has been treated of in detail, and where the Cape flicker (*U. chrysoides*), with red moustache, like *U. cafer* (or *mexicanus*), but with yellow shafts and without red nuchal crescent, like *U. auratus*, was also mentioned. Closely allied to the flickers are the South American ground flickers (*Soroplex*). The habits of the typical species, *S. campestris*, are described by Burmeister as follows: "This flicker is one of the first peculiar objects to attract one's attention when entering the open campos districts of the interior of Brazil. They are soon discovered hopping about on the lower trees in small companies, and the observer is greatly astonished to see one or the other once in a while jump down and walk about on the ground. This bird is especially engaged in search of the termites, and destroys the covered passages which these insects construct in the grooves of the bark in order to reach their nests undisturbed. But even these structures, strongly made of clay, the ground flicker knows how to open, and how to catch their inhabitants." The South African *Geocolaptes olivaceus* is still more partial to the ground, for, according to Layard, "it never pecks wood, but bores its way into the banks of rivers, sides of hills, or the walls of mud buildings, in search of its prey and for a home for its young."

The green woodpeckers, as the name indicates, are very conspicuous for their more or less green colors, ornamented, as in most woodpeckers, with red. A well-known representative of this group, which, as shown in the accompanying wood-cut, also spends part of its life on the ground, spearing unfortunate ants by its worm-like barbed tongue, is the yaffle (*Picus viridis*), the common green woodpecker of Europe, celebrated for its laughing voice, which it is said to produce especially at the approach of rain, and many a farmer on the other side of the ocean pays more attention to the 'indications' and 'probabilities' of this sagacious bird than to those of the meteorological stations. The three-toed Indian genus, *Cecinulus*, seems to be related to this group.

Before mentioning the typical pied woodpeckers we will have to say a few words of a somewhat peculiar form from India, as by some ornithologists it has been regarded as forming a 'sub-family' of its own. The short-tailed woodpeckers (*Hemicircus*) are especially remarkable for their short and rounded tails, the feathers of which are scarcely rigid at all. They are small birds, without red in their plumage, and but little is known of their habits. Mr. Jerdon says of *H. canente* that it has "on the centre of the back a brush of dark sap-green bristly feathers, smeared with a viscid secretion from a gland beneath."

A sort of transition from the foregoing to the pied woodpeckers (*Dryobates*) is formed by the oriental sub-genus *Yungipicus*, in which the lateral tail-feathers are less rigid than the central ones. *Dryobates* proper contains a great number of small or medium-sized species in the more northern parts of the two hemispheres. They are parti-colored, white and black, with red markings on the head and also often on the under side. Three European species are represented in the accompanying cut, from which, in a general way, our North American species differ but little except in not having the white tail-feathers barred with black. This difference is very curious, inasmuch as the Siberian representatives of the European species, and still more those which inhabit Kamtschatka, show a tendency towards losing the dark cross-bars; but this is followed by a general increase of the white all over the body, while in the Nearctic species the greater amount of white on the tail is independent of the dis-

tribution of the two colors elsewhere. A similar distribution of the colors is observable in *Picoides*, a circumboreal genus of three-toed pied woodpeckers, with a yellow crown in the male. The European species, *P. tridactylus*, is figured on the plate opposite p. 426, in order to give an idea of this interesting genus, which inhabits the northernmost forests in both hemispheres, but which also has a representative in the mountains of Chinese Tibet, the sombre-colored *P. funebris*.



FIG. 215. — *Dryobates medius*, *major*, and *minor*, European middle, greater and lesser woodpeckers.

Finally, we have to consider the thin-necked woodpeckers, a group of large forms, which have the feathers of the neck peculiarly short, thereby increasing the appearance of slenderness of the neck. That the neck of the woodpecker is usually smaller than the head, most collectors have discovered when skinning specimens, but externally this feature is most apparent in the present group. Most of the species are very large and powerful birds, with a considerable amount of black in their plumage, while the head, as usual, is adorned with more or less red. Here belongs the well-known great black woodpecker (*Dryocopus martius*), which inhabits the Palearctic region

from Europe to northern Japan, — black all over, with a crimson cap. Linnæus, indeed, dedicated this bird to Mars, the Roman god of warfare; but the evidence seems to show that this was not the woodpecker which the old augurs regarded as *Picus*, of whom the Roman mythology fabled that he was changed into a woodpecker by Circe when she found that her love for him was not requited, but was possessed by Pomona. In the



FIG. 216. — *Campephilus principalis*, ivory-billed woodpecker.

Oriental region are found several nearly allied forms; for instance, *D. leucogaster* from Java, which has the abdomen white and the sides of head and throat striped with the same color. Messrs. Motley and Dillwyn give the following interesting account of its habits:—

“These birds are not uncommon in Labuan, and frequently fly in small parties of six or eight. They much frequent dead trees whose bark is just beginning to fall,

and are very amusing to watch, being always in motion, and very noisy. They begin rather low down on a tree, moving upwards by jumps, with a cry like the chatter of a magpie to the time of our green woodpecker's laugh. Perhaps two or three will be ascending one tree at the same time, trying the bark with incessant taps, and wrenching open every likely crack with their powerful chisel-beaks. When they reach the branches, they hold a sort of discussion of tremendous chatter; and then each takes his own branch, and the bark here, being usually more decayed than on the stem, comes down in showers. If you make any loud noise, or show yourself suddenly, all disappear in a moment. Perhaps one or two may fly off, with a swift but laborious action of the wings; but the majority hide behind branches. In a minute or so, if all is quiet, you will see a head peer out from behind some snag, and, after looking around and seeing nothing, a croak of satisfaction brings out two or three more heads; but not a body is seen till all the heads are perfectly satisfied of their safety. At last they all come out, and chatter together most vociferously for a minute or two before they go on feeding. Though apparently so wary, they rarely leave the tree they are examining, even if fired at."

To this group also belong our pileated woodpecker, or log-cock (*Ceophlaeus pileatus*), and the 'prince' among the woodpeckers, as Linnæus called the magnificent ivory-billed woodpecker (*Campephilus principalis*). This is one of the largest and most striking looking birds of the whole family. It is found in the heavily timbered portions of our Southern States, especially those bordering the Mexican Gulf, but being a solitary and extremely wary bird, and not numerous even in those regions which may be regarded as its headquarters, it is rare in collections, and its habits are but little known. A nearly allied species, named *C. bairdi* in honor of Prof. S. F. Baird, is a native of Cuba; and another related species, *C. imperialis*, the 'emperor' woodpecker, is found in the mountain-forests of Mexico and Guatemala.

There has been great difference among authors as to the question whether the woodpeckers are to be regarded as injurious or not, as both sides have had, and still have, vigorous, and, as is too often the case, even fanatical advocates. The fact is, that the question cannot be affirmed or denied in its generality; for while one kind of woodpecker may be injurious, another may be beneficial, and even the same species may be injurious during one part of the year and beneficial during the rest, or injurious in one country and beneficial in another. Consequently, an author can scarcely adduce a fact to prove one side, without his opponent producing equally incontestible evidence for the opposite. The woodpeckers' digging holes in the trees is excused by their friends, who say that they never attack a sound tree, and that by hastening the destruction of already more or less rotten trees, they are decidedly beneficial; but there are undoubted cases where perfectly sound trees have been injured, though this is the exception. Other species are charged with stealing berries; and some might fancy that *Melanerpes formicivorus*, which is famous for its acorn-storing propensities, may do harm by depriving the hogs of their food, as in some parts of Europe they are prosecuted on the plea that by eating the seeds of the forest trees they prevent the forest from renewing itself. But these accusations are evidently insignificant compared with the enormous number of insects which the woodpeckers destroy; for insects, no doubt, are nearly in all cases their chief food. But not even this fact can be scored unconditionally to their credit; for they are justly charged with making no discrimination between injurious and beneficial insects, as some species of woodpeckers largely subsist upon ants, those great benefactors of the woods. We shall

not stop to consider the trifling injury they may cause by, in a few exceptional cases, boring holes in the weather-boarding of houses in order to store their acorns away, or digging breeding-holes in wooden church-steeple; but there is one small group of woodpeckers which, on account of their organization and their chief food, may be regarded as perhaps mostly injurious—viz., the so-called sap-suckers (*Sphyrapicus*). In these, the hyoid bones are not so excessively elongated, and the tongue consequently is protrusible only in a very slight degree. The tip is also differently armed, being simply brushed and not barbed,—features which indicate that the food of these birds is different from the rest of the woodpeckers, consisting as it chiefly does of the sap of the trees. The late Dr. Alfred E. Brehm was an enthusiastic defender of



FIG. 217.—*Jynx torquilla*, wryneck.

the woodpeckers. When, two years ago, shortly before his death, he visited this country, as we were standing at the entrance to the Smithsonian Institution, nearly driven to despair by the incessant din of the English sparrows which tried to drown our voices, he asked me to show him a characteristic American bird. Just at that moment a bird alighted on the trunk of the nearest tree, and I had the satisfaction of pointing out to him our common yellow-bellied sap-sucker (*S. varius*). As the bird reached the first branch, it thrust its bill into the smooth bark, leaving a square hole, easily visible from the moist sap which made it look dark against the dusty surface; and tap-tap-tap-tap, with an astonishing regularity and in a most business-like manner, the little fellow punctured the trunk horizontally and vertically until the tree looked as if it had suffered from small-pox, and 'Bird' Brehm, who had watched the per-

formance with extreme interest, admitted that the sap-sucker, under circumstances, may become an extremely injurious bird. Nevertheless, even this great offender is not entirely without his good sides; for we have Mr. William Brewster's word for it that "after the young have hatched it rises to the proud independence of a fly-catcher, taking its prey on wing as unerringly as the best marksman of them all. From its perch on the spire of some tall stub it makes a succession of rapid sorties after its abundant victims, and then flies off to its nest with bill and mouth crammed full of insects, principally large Diptera."

The wrynecks (*Jynxinae*) constitute a single genus (*Jynx*) of half a dozen species, which all belong to the Old World, especially Africa, while they are entirely wanting in Australia and America. They are rather small birds, with a wedge-shaped but not angular bill, and the tongue extensile. The tail is rather long, slightly rounded, consisting of twelve soft and rounded rectrices; the outer one on each side is very short, however, as in the woodpecker, and completely hidden by the under tail-coverts; the first primary is also very short, exceedingly so in the Palearctic species. The tarsus is scutellated both in front and behind. The coloration is a beautiful and intricate mixture of gray, buff, rusty black, and white, very difficult to describe, with a dark longitudinal band along the middle of the back and adjoining part of the neck, the African species with a large chestnut-brown patch on the throat and foreneck.

The wryneck or snake-bird (*Jynx torquilla*), the species depicted in our illustration, is a migratory bird, which in England arrives at the same time as the cuckoo; hence, it is also called the 'cuckoo's maid,' or 'cuckoo's mate.' The two first mentioned names are derived from a peculiar habit of twisting the neck with a slow, undulatory movement, like that of a snake, turning the head back and closing its eyes as in a fit, evidently with the intention of frightening its enemies. A captive held in the hand will usually perform this trick, and, taking advantage of the spectator's surprise at its strange behavior, suddenly escape. The wryneck's food consists of insects, especially ants. It breeds in hollow trees, and lays white polished eggs. Its cry is very much like that of the kestrel.

The trogons (*TROGONOIDEÆ*) are heterodactylous, that is, have the first and second toes turned backwards; no other birds are. The trogons are also heteropel-mous (see fig. 171 D); no other birds are. These features alone are, consequently, sufficient to distinguish the trogons from the other Picarians, but the chief characters may be briefly summed up in order to indicate the relationship of these birds. Their palate is desmognathous, and basipterygoids are present; the sternum is four-notched behind; the myological formula is A X; only the left carotid is developed; cæca are present, and the oil-gland is nude. The pterylosis is also in other respects very passerine, especially in the distribution and form of the feather-tract, but the after-shafts of the contour-feathers are very large; the long tail consists of twelve rectrices, the outer ones being graduated; the first primary is short. Altogether the trogons are rather peculiar, showing no special relationship to any other group of the present order, a circumstance which explains the fact that by the different systematists they have been associated with nearly all the groups of the Picarie.

The trogons form a very well circumscribed family, *TROGONIDÆ*, consisting of about fifty species, inhabiting the tropical regions. They are rather numerous in the Neotropical, less so in the Oriental region, and rare in Africa, and are, during the present geological epoch, entirely unknown in the Nearectic, Palearctic, and Australian regions. This was quite otherwise during a previous period; for, as Dr.

Wallace remarks: "Remains of *Trogon* have been found in the miocene deposits of France; and we are thus able to understand the existing distribution of the family. At that exceptionally mild period in the northern hemisphere, these birds may have ranged over all Europe and North America; but, as the climate became more severe, they gradually became restricted to the tropical regions, where alone a sufficiency of fruit and insect food is found all the year round."

We are not aware that there is any important structural character by which the trogons inhabiting the eastern hemisphere can be separated from those living in the western half of the globe. A considerable difference in their habits, however, is reported, inasmuch as the American species are said to be chiefly fruit-eaters, while Wallace informs us that the Old World forms subsist almost exclusively on insects. Very remarkable is the way by which the former are known to obtain the fruits. Their feet are comparatively small and weak, and, although in a measure 'yoke-toed,' they are entirely unfit for climbing; the trogon, therefore, darts from its perch after the fruit, like a flycatcher after an insect, seizes it while on the wing, and returns again to its perch. Such is also the habit of the most brilliant, most exquisite, and most celebrated of all the trogons, the quesal, according to Mr. Osbert Salvin's account. The quesal is only to be found in Central America, where it is represented by two but slightly differentiated forms, one in Costa Rica, the other, the more brilliant one of the two, in Guatemala, where it has been chosen for the national emblem. Imagine a bird of the size of a magpie, and with the splendor of a humming-bird or a sun-bird, and you may have an idea of the magnificent *Pharomacrus mocinno*. The whole upper surface, breast, neck, and head, including the curious rounded and compressed crest, are rich golden green, and so are the smaller wing-coverts, some of which are lengthened into gracefully drooping plumes, overhanging the wing; four upper tail-coverts, of a similarly brilliant green, are enormously lengthened, especially the two central ones, which in perfect specimens may reach a length of nearly three feet; the true tail-feathers are black and white, and the posterior part of the under side is rich vermilion inclining to crimson. Only the males are adorned with the long floating train, the females, as in most trogons, being much plainer.

Regretting that want of space forbids us to reprint the whole of Mr. Salvin's account of his 'quesal-shooting in Vera Paz,' we take the liberty to make a few extracts bearing directly on the habits of this remarkable bird:—

"My companions are ahead, and I am just balancing myself along the last trunk, when Filipe comes back to say that they have heard a quesal. Of course, being especially anxious to watch as well as to shoot one of these birds myself, I immediately hurry to the spot. I have not to wait long. A distant clattering note indicates that the bird is on the wing. He settles—a splendid male—on a bough of a tree not seventy yards from where we are hidden. It sits almost motionless on its perch, the body remaining in the same position, the head only moving slowly from side to side. The tail does not hang quite perpendicularly, the angle between the true tail and the vertical being perhaps as much as fifteen or twenty degrees. The tail is occasionally jerked open and closed again, and now and then slightly raised, causing the long tail-coverts to vibrate gracefully. I have not seen all. A ripe fruit catches the quesal's eye, and he darts from his perch, hovers for a moment, plucks the berry, and returns to his former position. This is done with a degree of elegance that defies description. A low whistle from Cipriano calls the bird nearer, and a moment afterwards it is in my hand,—the first quesal I have seen and shot.

"The cries of the quesal are various. They consist principally of a low double note, 'whe-oo, whe-oo,' which the bird repeats, whistling it softly at first, and then gradually swelling it into a loud but not unmelodious cry. This is often succeeded by a long note, which begins low, and, after swelling, dies away as it began. Both these notes can be easily imitated by the human voice. The bird's other cries are harsh and discordant. The flight of the quesal is rapid and straight; the long tail-feathers, which never seem to be in his way, stream after him. The bird is never found except in forests composed of the highest trees, the lower branches of which (*i. e.*, those at about two-thirds of the height of the tree from the ground) seem to be its favorite resort. Its food consists principally of fruit, but occasionally a caterpillar may be found in its stomach."

In most of the American species of the true trogons a certain uniform distribution of colors is apparent, since the back and breast are either metallic green or brownish, and the abdomen red or yellow, separated from the breast by a white band. It may be remarked that this red or yellow of the lower parts in the trogons is very evanescent, fading entirely out in museum specimens exposed to the light. In the two West Indian genera, each consisting of one species, *Priotelus* and *Temnotrogon*, the former restricted to Cuba, the latter to the island of Haiti, the upper parts are metallic green, posterior half of under parts brilliant red, while the anterior half is delicately gray. While in most trogons the tail-feathers are somewhat square at the end, this peculiarity is rather exaggerated in the West Indian forms, especially in the Cuban *Priotelus temnurus*, in which the corners are produced into points, thereby making the end concave, and forming a most remarkable tail. This latter form is known to the Cubans as the 'tocororo,' a name derived from its cry. Dr. Gundlach reports that it breeds in abandoned woodpecker holes, and deposits three to four white eggs which have a slight bluish tinge. This, like some other American forms, has the edges of the mandibles strongly serrated. The African genus, *Apaloderma*, has only the lower mandible serrated, while the Indian *Harpactes* only have a notch before the tip of the upper one. These, according to Jerdon, seize insects on the wing, much in the same manner as the American species secure the fruits.

Figure 218 represents the African species, *Apaloderma narina*, which is metallic green on the back, head, and breast, while the rest of the under parts are brilliant carmine, the bill yellow; it is, consequently, very similar to the American species in coloration. Layard says that when apprehensive of discovery it sits motionless on its branch until alarmed at some act of the fowler, when it precipitates itself headlong into the bush, and is instantly lost to view. It feeds, he further states, on fruits and insects, and utters a loud moaning note, or, perhaps, more correctly speaking, a hoot. A nearly allied species from Western Africa was described in 1872 as *A. constantia*.

The last super-family of the Picariæ, the MICROPODOIDEÆ, was originally founded by Nitzsch, who in his 'Macrochires' only included the swifts and the humming-birds. It is also synonymous with Garrod's 'Cypseliformes,' the former basing his conclusions chiefly upon osteology and pterylography, while the latter also employed the anatomy of the soft parts. Huxley united them with the goatsuckers in the group 'Cypselomorphæ,' taking chiefly the palatal bones into account; but Parker has shown that this structure is so different in the three families that it offers no character which would bind them together to the exclusion of other birds. In this place we shall only call attention to those characters which at once separate the

present super-family from the Caprimulgidae. Osteologically the swifts and humming-birds resemble each other closely in all respects except in the shape of the bones of

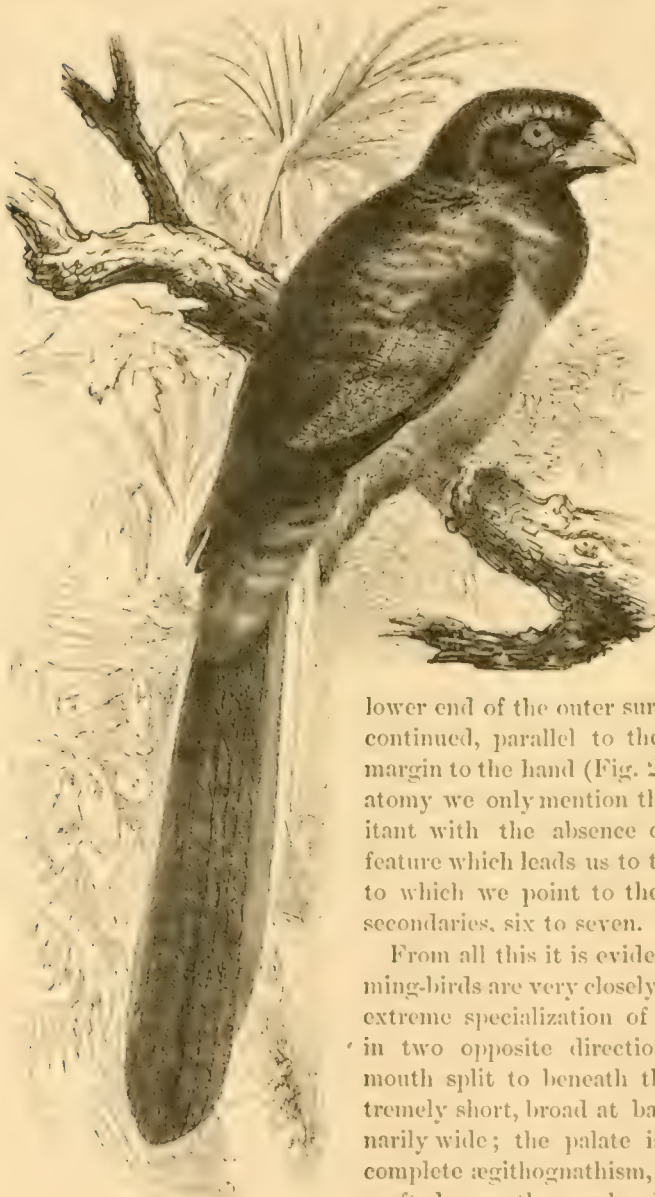
the face. The breastbone is highly characteristic, having a high keel, and an entire, unnotched posterior margin. The proportions of the different sections of the wings are also noteworthy, the humerus being very short, the forearm longer, and the hand extremely long, whence Nitzsch's name of the group. The myological formula is $A+$, unique amongst Picarian and Passerine birds, and only shared by the owls. The tensor patagii brevis is quite peculiar, no tendon being developed, and the fleshy belly running on to a special tendon which springs from the

lower end of the outer surface of the humerus, and is continued, parallel to the forearm, along the radial margin to the hand (Fig. 219). As to the visceral anatomy we only mention the absence of caeca, concomitant with the absence of tuft to the oil-gland, a feature which leads us to the pterylography, in regard to which we point to the uniquely small number of secondaries, six to seven.

From all this it is evident that the swifts and humming-birds are very closely allied, notwithstanding the extreme specialization of the facial part of the head in two opposite directions. The swifts have the mouth split to beneath the eyes, and the bill is extremely short, broad at base, and the gape extraordinarily wide; the palate is built on the principle of complete agithognathism, "the vomerine bones being grafted upon the nasal wall." In the humming-birds, on the other hand, the bill is long and narrow, the mouth not split, consequently the gape also narrow, and the palate is, according to Parker, schizognathous,

FIG. 218.—*Apaloderma narina*, African trogon.

the vomer being pointed anteriorly, and only tied to the alinasal wall by a fibrous ligament, but not grafted upon it. But even in the palatal structure the relationship between swifts and humming-birds is manifested by the development of the maxillo-



palatines of the young, as pointed out by Parker, who says that in the young humming-birds they agree *in general* with young Passeres, "but *in particular* with both young and adult of that family of birds which has most similarity to them in general bodily structure, namely, swifts."

In view of the extreme external 'isomorphism' of the swifts and the swallows, and the remarkable tenacity with which ornithologists have stuck to arrangements based chiefly upon the external appearance, the comparatively early recognition of their being totally different on account of their internal structure would be somewhat surprising but for the fact that there are also a number of easy external characters by which they are at once separated. The swifts, or *Micropodidæ*, and the swallows are, indeed, "only 'second cousins,' and more alike in their habits and mode of dress than in their real nature," as will be apparent by the following juxtaposition of their differences. Externally they may be easily distinguished; the swifts by having ten primaries, not more than seven secondaries, and only ten tail-feathers, while the swallows have but nine primaries, at least nine secondaries, and twelve tail-feathers. The swifts have also the dorsal tract bifurcate between the shoulders, while in the swallows it is simple. Internally they differ in a great number of points, but we shall only mention that the swifts have a pointed manubrial process and no posterior notches to the sternum, while the swallows have the manubrium bifurcate, and the posterior border deeply two-notched; the former have a myological formula $\Lambda \div$, the latter $\Lambda XY \div$; the former are synpelmous, the latter are schizopelmous; the former have a peculiar arrangement of the tensor patagii brevis, the latter have the general arrangement of the Passeres, to be explained in the introduction to that order; the former have a simple syrinx without intrinsic muscles, the latter have a very specialized syrinx; the former are without cæca, the swallows possess them, etc., the total effect being that the swifts are Picarians, and the swallows are Passeres.

The swifts are found all over the globe, except in the extreme cold regions and in New Zealand, being most abundant in the tropics of America and the Oriental region, considerably over fifty species being known altogether. The peculiar structure of the feet furnishes excellent characters for subdividing the family in two minor groups or sub-families, the *Micropodinæ* and the *Chæturinæ*. The latter have the feet normally constructed with the usual number of phalanges, viz., 2, 3, 4 and 5, while the true swifts have the number of phalanges of the third and fourth toes reduced to three, the formula, consequently, being 2, 3, 3, 3. At the same time the first toe is directed more or less forwards or inwards; in other words, the true swifts are pamprodactylous. Another feature is that their tarsi are feathered, while the *Chæturinæ* have them bare.

Regarding the *Chæturinæ* as the more generalized type, we are at once confronted with the pretty tree-swifts (*Dendrochelidon*) from India and the Malay Archipelago, which are provided with a feather-crest on the head, and very lengthened outer tail-feathers. In the same regions, and also in many of the Polynesian islands (one species even in Madagascar), are found the pigmies of the family, the so-called swiftlets (*Collocalia*), inconspicuous looking, dusky-colored birds, but famous as the manufacturers

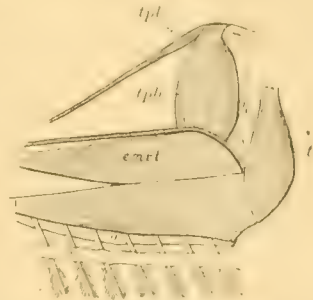


FIG. 219. — Diagram of the elbow-muscles in a humming-bird (*Patagona gigas*); muscles with longitudinal, tendons with transverse lines; *emrl*, extensor metacarpi radialis longus; *h*, humerus; *sr*, secondary remiges; *t*, triceps; *tptb*, tensor patagii brevis; *tpt*, tensor patagii longus.

of the 'edible bird's-nests.' They breed in deep caves, fastening their gelatinous nests to the rocky walls. It was formerly the belief that the substance which composed the nests was digested algæ growing on the sea-beach or on the walls of the caves, mixed with the excretion of the salivary glands, but it seems now certain that it consists solely of mucus. Mr. H. Pryer, who recently made a visit to the caves of Gomanton, northern Borneo, situated in a high limestone cliff twelve miles inland from the head of Sandakan Bay, last year published an interesting account of the breeding there of *Collocalia fuciphaga*, from which we select the following:—

"After a rest, I ascended the cliff about four hundred feet; the ascent is quite perpendicular: in many places ladders are erected, and in others the water-worn surface of the limestone gives a foothold. At this point I found myself at the mouth of a cave named Simud Putih, *i. e.*, the White Cave; the entrance is about forty feet high, by sixty feet wide, and descends very steeply, widening out to a great size, and having a perpendicular unexplored abyss at its furthest point. This cave is used by the nest-gatherers as their dwelling-place, and at the entrance are their platforms of sticks, one of which was placed at my disposal by the head man; it is also the cave by which the great body of the swifts enter.

"At a quarter to six (p.m.) the swifts began to come in to Simud Putih; a few had been flying in and out all day long, but now they began to pour in, at first in tens and then in hundreds, until the sound of their wings was like a strong gale of wind whistling through the rigging of a ship. They continued flying in until after midnight, as I could still see them flashing by over my head when I went to sleep. As long as it remained light I found it impossible to catch any with my butterfly-net, but after dark it was only necessary to wave the net in the air to secure as many as I wanted. Nevertheless, they must undoubtedly possess wonderful powers of sight to fly about in the dark in the darkest recesses of their caves, and to return to their nests, often built in places where no light ever penetrates.

"Arising before daylight, I witnessed a reversal of the proceedings of the previous night, the swifts now going out of Simud Putih.

"In this cave I saw the nest-gatherers at work getting in their crop. A thin rattan ladder was fixed to the end of a long pole and wedged against the rock; two men were on the ladder, one carried a long four-pronged spear, a lighted candle being fixed to it a few inches below the prongs. By the aid of this light a suitable nest is found, and transfixed with the prongs; a slight twist detaches the nest unbroken from the rock; the spear is then withdrawn until the head is within reach of the second man, who takes the nest off the prongs and places it in a pouch carried at the waist. The nests of best quality are bound up into packets with strips of rattan, the inferior being simply threaded together; the best packets generally weigh one catty (1½ lbs.), averaging forty nests, and are sold at \$9 each, the annual value of the nests gathered being about \$25,000. These caves have been worked for seven generations without any diminution in the quantity; three crops are taken during the year."

Mr. J. R. Green, of the Physiological Laboratory, Cambridge, Eng., reported on the nests collected as follows:—

"The specimen gave no evidence under the microscope of any distinct vegetable structures, and similarly gave no chemical evidence of either cellulose or any other distinctly vegetable product. All the relations went to prove that the great mass of the substance was *mucin*, and such microscopic features as were apparent confirmed the view that the nest was formed of strings of mucus plastered together. The

mucus, when separated out, gave some reactions different to a certain extent from those which are given by ordinary mucin; but these differences were not great enough to weaken the conclusion that the nest is really composed of mucus secreted by the peculiar glands superficially described by Sir Everard Home as present in the bird which builds the nest."

Another group of this same sub-family have the tail-feathers rigid; and in some, as, for instance, our common chimney-swift (*Chætura pelagica*), the ends of the shafts protrude beyond the end of the rectrices as so many spines. I need not dwell on the well-known facts of the change of habits in these birds since the white man took possession of this continent: how they in a great measure gave up the hollow trees as roosting and nesting places, choosing his sooty chimneys as more accessible and possibly more convenient, though to me personally it was a novel sight when a few years ago a good friend of mine on a pleasant evening took me out in the country to an old brick-yard, where hundreds of swifts circled around the high chimney, one after the other dropping into the opening, as may-flies into an electric lamp. The chimney-swift, or chimney-swallow, as it is often, but erroneously, called, is, like all swifts in temperate climates, a regular migrant, which passes the winter in Mexico. There is, therefore, no necessity for supposing "that it hibernates in hollow trees," or in the mud beneath ponds, as is often asserted. Swallows and swifts may *occasionally* be found in a torpid state, but the same is the case with all other kinds of birds, and even with man, for that matter; but from such an occasional, exceptional, and probably pathological case to conclude that the swiftest birds on the wing, which with the greatest ease in a few days can travel from the Arctic circle to a tropical climate, regularly hibernate in hollow trees "is preposterous," as an esteemed contemporary has put it. Juridical evidence may perhaps be adduced to the effect that swallows hibernate in the mud or on the bottom of lakes; but how many hundred old women have not been burned to death as witches on juridical evidence! Nor has anybody yet succeeded in introducing the ghost into the zoological system, although we might produce juridical evidence in confirmation of his existence.

Remarkable as is the nidification of the swiftlets and the chimney-swifts, that of some of the true swifts (*Micropodinae*) is not less wonderful. Messrs. Godman and Salvin describe the nest of *Panyptila sancti-hieronymi*, which they discovered in Guatemala, as composed entirely of the seeds of a plant, secured together and hung from the under surface of an overhanging rock by the saliva of the bird. The whole forms a tube two feet and two inches long by about six inches in diameter. The entrance is through the lower end of the tube, and the eggs are placed on a kind of shelf at the top. About the middle of the tube, on the external side, is a protruding cave, as if overvaulting an entrance; but there is no hole, and it has the appearance as if it was placed there on purpose to deceive some enemy, such as a snake or lizard, to the attacks of which the parent bird or its offspring would, during the time of incubation, be more exposed. A section of the nest is given in the accompanying cut.

The genus to which the foregoing species belongs have the first (hind) toe turned inwards. In the typical, or, rather, most specialized swifts, *Micropus* (or *Cypselus*), it is directed forwards like the other toes. Both birds represented in the accompany-



FIG. 220. — Section of the nest of *Panyptila sancti-hieronymi*.

ing cut belong here, and are two well-known European species, the Alpine swift (*M. melba*), larger, brownish gray, whitish beneath with a dusky gorget, from the southern parts, and the common swift (*M. apus*), sooty black all over, except the whitish throat, of more general distribution. It nests under the tiles of the roofs or in church-steeple, and makes itself very conspicuous in the evening by circling and hawking around the building in small troops, keeping up an incessant and penetrating scream as they pass by with incredible rapidity of flight. The North American white-throated swift (*M. melanoleucus*) is nearly allied.



FIG. 221. — *Micropus melba*, Alpine swift (upper figure); *M. apus*, common European swift (lower figure).

There is found in tropical America a group of small swifts, outwardly resembling the swiftlets very much, but so closely allied to the above that a separate generic name (*Tachornis*) is now thought to be superfluous. A member of this group is the Jamaican palm-swift (*Micropus phœnicobia*), which we mention specially for its interesting nest-building. Gosse describes namely two entirely different nests of this bird according to whether they build in a cocoanut palm or a palmetto. In the former case they were formed chiefly in the hollow spathes of the leaves, and were

placed in a series of three or four in a spathe, one above another, and agglutinated together, but with a kind of gallery along the side, communicating with each. The material seemed only feathers and silk-cotton (the down of the *Bombax*); the former very largely used, the most downy placed within, the cotton principally without, the whole felted so strongly as to be almost as tenacious as cloth. On the palmetto leaf, instead of the hollow of a spathe, they were attached to the plaited surface of the fronds. They were composed almost exclusively of the silk-cotton, and in the form of those watch-fobs which are hung at the head of the bed, the backs being firmly glued by saliva to the under surface of the fronds.

LEONHARD STEJNEGER.

The humming-birds, solely found in the New World, are most abundant in South and Central America, with a few species extending into North America as far as Nootka Sound and Canada. The family TROCHILIDÆ cannot be divided into any sub-families, as no genera are so essentially different from all the rest as to require them to be separated in such a radical manner. 'Hummers,' as they are often called, are Picarian birds, having but one carotid artery, — the left, — a naked oil-gland, and no cæca. They have small, sometimes minute, bodies, with bills varying from feeble to stout, usually longer than the head, in one instance exceeding the body in length, usually straight, but in one group it is curved to a third of a circle, with a short gape, and no bristles. Nostrils are placed near the base of the maxilla, and are covered by a scale, though sometimes they are hidden in the frontal feathers. The tongue, which is very slender, and capable of great extension, curves around and over the back of the skull, similarly to a wood-pecker's, and consists of two minute parallel tubes, through which the sweetened juices of flowers are drawn into the throat. The wings are narrow and pointed; the primaries, always ten in number, are stiff and lengthened, the secondaries very short. The manus is very long, and the humerus extremely short, which enables the bird to move the wing with great rapidity. Sternum large with a very deep keel, pectoral muscles in consequence very powerful for the size of the bird. The tail always possesses ten rectrices, except in *Loddigesia mirabilis* which has but four. The tarsi are short, either naked, partly clothed, or hidden in tufts of feathers. The feet are small with short toes, and curved sharp claws. The plumage varies from plain sombre tints to the most brilliant metallic hues that it is possible to conceive. In all cases the male is the one most attractively adorned.

The food was at one time supposed to consist solely of the nectar obtained from flowers, and at times, or during certain seasons of the year, this may be the case, but it has been fully ascertained that various kinds of insects also form a large proportion of their sustenance, and some genera feed almost entirely upon insects. The probability is that these fairy creatures require both insect food and the juices of flowers, and these are partaken of equally whenever the opportunity to obtain them presents itself. The flight of these birds is usually of great swiftness; the wings move with such rapidity that they are invisible, each wing working a half circle. Some species, like *Patagona gigas* and *Pterophanes temminckii*, move their wings, when hovering over a flower, with a slow motion, evincing considerable power. At this time the tail is closed and expanded with a motion like a fan. They are capable of making most astonishing aerial evolutions, darting in every direction with the speed of light, arresting their course instantaneously at will.

Nearly all humming-birds are exceedingly quarrelsome in disposition, both during the breeding season and other times as well. Some will not permit others to remain

in the same vicinity, nor touch a flower on the tree on which they are perched, and the smallest species does not hesitate to attack those of the largest size, hawks even having been driven quite away by the furious attacks of one of these irascible little creatures. The general sound emitted by humming-birds is a sharp shrill twit or cry, but some species possess a few notes almost attaining to the dignity of a song. The little *Mellisuga minima* is stated to sing very sweetly, and a diminutive *Phacothornis* is also said to have the same accomplishment. These birds, in certain districts of South America, have regular migrations from north to south, and vice versa, also from higher to lower altitudes, caused mainly by the blooming and fading of the flowers, as it is apparently necessary for their existence that they should live always in the midst of blossoming plants. In the early spring the species inhabiting high latitudes descend to meet the blooming of the plants, returning to their more lofty abodes as summer advances. As a rule humming-birds appear to be devoid of fear. They will fly within a few inches of a person's face, stop and peer at him, approaching so close as to fan one with their wings. Frequently they will enter a house through the open window, and after flying around until wearied will alight on any convenient perch, and prune their feathers; or if taken in the hand will immediately feed upon any sweet that may be offered them, without exhibiting the slightest fear. In this respect they in no way resemble birds, acting more like insects.

The nests of these beautiful creatures are wonderful structures, and exhibit great variety of form and of the materials used in building. Some are not larger than walnut shells. They are generally shaped like a cup, lined with some soft material such as hair or wool, and much diversity of taste is shown in the mode of decoration placed upon the exterior; these ornaments, consisting of lichens, bark, moss, etc., being usually attached by means of cobwebs. These nests are placed in all manner of situations, on slender twigs, or on the bifurcation of a branch; some attached to the side of a drooping leaf; while others again suspend themselves to the sides of rocks. The members of the genus *Oreotrochilus* build quite large nests, composed of wool, hair, moss and feathers, and make in the top of this a small depression in which the eggs are laid. One of these great nests was found by Professor Jameson of Quito in a room of a deserted house, attached to a rope suspended from the roof. A curious evidence of instinct shown by these birds, is witnessed in these nests, where one side having proved to be lighter than the other, it was weighted by a small stone or piece of earth, until the equilibrium was restored and all danger of the eggs falling out was removed.

In our limits it is quite impossible to give more than the most cursory review of the more prominent birds composing this family. About four hundred species are acknowledged at the present time, contained in one hundred and twenty genera. The classification of these, is, of necessity, largely artificial.

Beginning at the bottom, or with those species usually assigned to that place, we commence our review of the family with the minute species generally known as the 'green hummers.' In this group is comprised the genera *Panychlora*, *Chlorostilbon*, *Sporadinus* and *Cyanophaia*. The species inhabit Mexico, Central America, various portions of South America, and some islands of the West Indies such as Haiti and Puerto Rico. They are very small, being from two and three quarters to four and a half inches in extreme length. Their plumage is shining, brilliant green, in some species, with golden-bronze reflections, the tail short and usually even, except in *Chlorostilbon auriceps* and the species of *Sporadinus* and *Cyanophaia* which have

forked tails. *Cyanophaia caruleigularis* differs somewhat from others in this group of genera by having a violet-blue throat and cheek. About eighteen species are included in the four genera named.

The next four genera are composed of species clothed in blue and metallic green. They are *Hylocharis*, *Iache*, *Damophila* and *Julianmyia*, and are represented in Mexico, Central America, and portions of South America. *Hylocharis cyanea* from Brazil, with the head, throat, and breast shining dark blue with violet reflections, builds a most beautiful nest, which is attached to a tendril of some vine, and is cup-shaped and composed of a white, cottony, substance, intermingled with seeds of thistle-down, coated with dried leaves and bound together with cobwebs, all decorated with woody fibres, inner coating of bark of trees, and other materials. These nests, however, are not always alike, seemingly the fancy of each individual builder having much to do with the choice of materials for the construction and adornment of these fairy dwellings. The eggs are always two; and pure white, as is the case with all species of humming-birds. Another allied species, *H. sapphirina* has a remarkable red-colored fleshy bill much dilated at the base.

Three genera, *Timolia*, *Eucephala*, and *Basilinna*, with twelve species, have metallic green and blue plumage, the females very differently clothed from the males, as is indeed the case with those of most of the species belonging to the genera thus far enumerated. Perhaps the finest species of the three genera mentioned is *Eucephala grayi*, with the whole head and chin shining deep blue, rest of body golden green. It comes from Ecuador. *Amazilia* has twenty-five species, birds of various styles of plumage. Some have breast of metallic hues, others have this part plain rufous; some have red backs, while others again have the abdomen pure white. They are natives of Mexico, Central America, Tres Marias Island, Colombia, Ecuador and Peru, one species, *A. niveiventris*, having been procured in Panama. Two species from Guatemala, Costa Rica, and the islands of Tres Marias, *A. cinnamomea* and *A. graysoni* differ from all the rest by having the entire under surface bright cinnamon color.

The genus *Polytmus*, with three species, stands somewhat isolated among the Trochilidæ. Their tails are rounded, with narrow, somewhat pointed, rectrices; entirely metallic green in two species; in the other, with basal portion white. They are scattered throughout South America. The two species of *Elvira* have the greater portion of the tail white,—a very unusual feature among the Trochilidæ. *Argyria* is one of the most extensive genera, as regards the number of species, in the family. They are birds of moderate size and of a pleasing plumage, the chief colors of which are green and white. *Uranomitra* has some species with very brilliant metallic green and blue hues upon the head and upper surface, and also certain ones possess bright red bills. The genus *Panterpe* contains one very beautiful species, *P. insignis*, from Costa Rica and Chiriqui. With the crown and breast rich blue, the throat is metallic scarlet, bordered with luminous yellowish green. It is one of the most brilliant birds of this portion of the family.

The genus *Eriocnemis*, with about eighteen species, is remarkable for the coloring of the lower part of the back in the different species, and the downy puffs which cover and completely conceal the tarsi, sometimes the entire feet. The metallic colors are golden-green, blue, bronze, and others of similar brilliancy, while the general hues of the species are dark gray, green, coppery-red, and purplish-black. The downy puffs on the legs are black, white, pale buff, or brown and white. The species are of moderate size, rather robust form, with straight, strong bills, and long wings. A very

curious group is contained in the genus *Aglæactis*. Of rather large size, these birds have a coloration similarly distributed to that of the species of *Eriocnemis*, but the manner of exhibiting this is different. The feathers of the rump are highly luminous, but in order to see the full beauty of these hues, it is necessary to look against the feathers, or towards the head, when the brilliancy of the metallic sheen is seen to the best advantage. There are four species from the western part of South America, from Colombia to Bolivia. The females resemble the males, as do those of the genus *Eriocnemis*, but have very much less brilliancy on their plumage.

Cephalolepis and *Bellona* contain species with more or less lengthened crests, to which the metallic hues of the plumage are confined, there being none upon the lower part of the body. The crests of the two genera differ much in shape, that of the species of *Cephalolepis* being long, rather loose, and terminating in from one to three narrow feathers extending beyond the rest. That of *Bellona* is broad and pointed, of moderate length, and the feathers of the forehead project forward and cover one half the length of the culmen. The species of this genus are natives of the West Indies. *Chrysolampis moschitus* is the ruby and topaz humming-bird, so called from the brilliant metallic hues of the top of the head and throat. Like the species of *Bellona*, the feathers of the forehead project over the culmen, and the male possesses all the beauty of plumage, the female being a plainly dressed, quiet-looking little bird. The species is of considerable commercial importance, thousands being shipped to Europe and other countries every year, giving employment to numbers of the inhabitants of its native land. It makes a round, cup-shaped nest, of some cottony materials, and decorated with leaves and lichens. It perches occasionally on the flowering shrubs it frequents, and spreads its rounded, chestnut-colored tail to its fullest extent, and then appears to the greatest advantage.

Three species of humming-birds, of rather large size and most graceful form, are included in the genus *Heliothrix*, distinguished by their slender, wedge-shaped bills, plumage of green and white hues, and metallic-blue tufts on the sides of the neck. There is not much difference in the coloring of the sexes, but when any does exist, it consists in the absence of metallic coloring on the female's throat. The rectrices, which are rounded, are quite long, always shortest, however, in the male. The species dwell in Central and South America generally. *Heliothrix auriculatus*, from southern Brazil, and a bird of a powerful and rapid flight, evinces a preference for the flowers of the orange-trees, which doubtless furnish it with its insect food. The nest, which is of an elongated shape, is built of fine vegetable fibres, and coated externally with small pieces of various colored barks, and attached by one side to some twig. Like in other species, the materials composing the nest are not always of the same kind, the bird apparently taking that which is most convenient and adapted for the purpose.

The genera *Schistes*, *Phlogophilus*, *Augastes*, *Chrysuronia*, *Metallura*, and *Avocettula* contain about twenty-one species, resembling each other in the bright metallic coloration of their rectrices, though differing in other important respects. *Schistes* contains but two species, confined to Ecuador, one (*S. personatus*) having been procured upon the sides of Mount Pichincha, six thousand feet above the sea. It has the forehead, face, and throat metallic green, with lilac-blue tufts on either side of the breast. The members of *Augastes* are more brilliant birds than are those of the last genus, *A. lamachellus* being particularly beautiful. It has the top of head, ear-coverts, and a line outside of throat velvety black; forehead, face and throat luminous golden

green, bounded beneath by greenish blue, below which is a tuft of metallic reddish orange, each side of which is a white bar; tail, metallic bronze-red, very brilliant. The members of *Metallura* are dispersed over the mountains of the great Andean range, from Colombia to Bolivia. One of the commonest and best known, *M. tyrianthina*, is scattered over the mountains and valleys of New Grenada and Ecuador, and feeds upon the insects found in all the different flowers and plants of those countries. It bears the cold well, is not sociable, has a rapid flight, and makes its nest in ravines and spots shaded from the sun and rain. The sexes differ much in hue of plumage. The male is not of very generally brilliant plumage, though it has a luminous throat, but the tail shines with metallic purple-bronze; this is also possessed by the female, though lighter in hue. *Avocettula* has but one species, a native of Guiana, but remarkable for the bill, which is turned upward at the point, like an avocet's. In this respect it agrees with *Avocettinus*, but it also possesses a tail of fiery copper-red, resembling in this character the members of those genera with which it is grouped. Not much is known of this curious bird, but it is said to live isolated in the great forests. Swainson suggested as a cause for the curiously formed bill that the bird's principal sustenance may be drawn from the pendant *Bignonia* and similar plants, whose corollas are long and generally bent in their tubes; the nectar, being at the bottom, could not be readily reached either by a straight or incurved bill, though very easily by one corresponding to the shape of the flower. It is not a common species, and but few examples comparatively have been procured.

Rhamphomicron and *Oreonympha* comprise a group of humming-birds remarkable for the pendant metallic feathers, denominated 'beards,' beneath the throat. They are birds of rather large size, without crests, with short and feeble bills in most of the species, and constitute a well-marked section of the Trochilidae. They are found from Colombia to Bolivia, one species, *R. stanleyi*, dwelling (among other localities) in the crater of Pichincha, where it rifles the flowers of the *Chiquiraga insignis*, and continually battles with its far more attractive rival, *Oreotrochilus pichincha*. It is a very sombre-plumaged bird, with the upper surface bluish violet; beneath, sooty brown, and tail, bluish green; throat, metallic green, terminating in lengthened amethyst-colored feathers. A far more beautiful species is *R. herrani*, a native of Colombia and Ecuador. It remains motionless usually during the day, flying in the early mornings and evenings, is peacefully inclined, but is frequently pursued and attacked by other species of humming-birds that are in its vicinity. It makes short flights from branch to branch, and explores the flowers to obtain its insect food. This beautiful bird has the crown rusty-red; chin, luminous metallic-green; beneath this are elongated metallic-red feathers, bounded on either side with black. The upper surface is bronzy green; rump, bronzy rufous; tail, purplish black; lateral feathers tipped with white. *Oreonympha nobilis* is a magnificent species, about seven inches in length, with a long, somewhat stout bill. It has forehead and centre of crown black; top of head dark blue; cheeks and sides of throat black; throat colored similarly to the species of *Rhamphomicron*, but the pendant feathers are longer. The upper surface is bronzy brown; under surface, grayish white; the tail, bronze, except the external feathers, which are white. This species was first obtained at Tinta in Peru, at an elevation of 11,500 feet. The flight of this beautiful bird is stated to be very peculiar. It starts from one flower in the direction of another some two or three hundred yards away, when suddenly it comes to a stop, throws up the body vertically, the tail being spread out, and exhibits the metallic crown and beard glistening in the sun's rays. This

action, which is often repeated, is probably effected for the purpose of taking insects in the air.

The genus *Sappho* contains species the magnificence of whose plumage cannot be described by words and is very inadequately exhibited by the best colored representation. They are known by the common name of 'fire-tails,' and are natives of Peru, Bolivia, and the Argentine Republic. The tails of the males blaze with the radiance of flashes of flame, and their ruby backs, luminous green throats, and under surface



FIG. 222. — *Sappho sparganura*, fire-tail.

present a *tout ensemble* unparalleled in the range of Ornithology, not even excepting the gorgeously attired species of the birds-of-paradise. *S. sparganura*, the longest known species, is a denizen of Bolivia and the Argentine Republic. It appears when the fruit trees are in blossom, and particularly resorts to the Capuli, a kind of cherry. It frequents the fields of maize, pulse, and other leguminous plants, and the rich flowers of the cacti which afford them abundant food. It is by no means shy, and the males are constantly warring with and chasing each other, uttering sharp cries. It is a very pugnacious species, and each individual resents the intrusion of another within

its chosen territory. The nest is about two and a half to three inches in length, composed outwardly of interlaced vegetable fibres, twigs, moss, etc., and lined with soft hair, etc. It is placed in some gully, and attached to any hanging root or twig that will afford it support. The eggs are oblong in shape, and pure white. When on the wing, this bird makes extraordinary turns and rapid evolutions, at one moment darting headlong into a flower, at another describing circles in the air with such rapidity that the eye is unable to follow it. The female is less brilliant in plumage, but has a tail of metallic colors, save the external feather which is white on the outer web. Total length of males six and three quarters inches.

Next to *Sappho* comes *Cynanthus*, with two species, also having lengthened tails adorned with metallic hues, but less showy, for the colors are blue and green instead of brilliant red and black.

Lesbia possesses four species, with very long rectrices of rather narrow but even width for their entire length, and having generally a luminous tip. All the species have metallic green throats, and differ from each other in size and in the length and coloration of their tails. The females are very different in appearance, having white breasts spangled with green, and comparatively short tails. The best and longest known species is *L. amaryllis*, from Colombia and Ecuador. It frequents the gardens in the city of Quito, and is familiar to every one, and is equally common at Bogota. When poised in the air, with tail outspread over a flower it makes a loud humming noise. The males are very pugnacious and frequent combats take place between them, and these are persisted in with great energy until one is driven away.

One of the most extraordinary birds known to naturalists, the wonderful *Loddigesia mirabilis*, is remarkable for having only four rectrices, the two median ones very short, and entirely hidden by the coverts. The outer ones are greatly lengthened, some three or four times the extent of the body without the bill, the shafts destitute of webs until the tips are reached, when they terminate in large indigo-colored spatules. These rectrices are curved throughout their entire length into a semi-circle, so that in the natural position of the tail they cross each other twice; at first near their base, and then, at about a third of their length, the remaining portion takes a direction directly across the axis of the bird's body. The under tail-coverts are long, but the two middle feathers are much longer than the body of the bird, gradually diminish in width, and terminate in a point. This structure of the tail is absolutely unique among birds. This species was first procured by an English botanist, Andrew Matthews, fifty years ago at Chachapoyas in Peru, and the specimen remained unique until the year 1881, when M. Stolzmann procured a series of examples in the vicinity of the same place from which the type originally came, but the birds appeared to be localized in the basin of the Utcubamba, a little river on the right bank of the Marañon. It is found only at an altitude between 7500 and 9000 feet above the ocean. The country inhabited by this extraordinary bird is covered with cultivated fields, small valleys with more or less vegetation, and here and there large trees, the probable remnants of ancient forests. A beautiful red-colored *Alstromeria* is the favorite flower of this bird, and wherever this is met with the *Loddigesia* is sure to be found, and as the *Lesbia gracilis*, its chief persecutor, does not visit this flower, the present species can rest unmolested. Even in the localities it frequents this bird is not common, the adult males rather rare. From morning to night it is in constant motion; its flight is inconceivably rapid, and it is remarkable with what unerring precision it traverses the thickets where it is obliged to change its course almost every second to escape from

the obstacles in its route. When it flies, the lateral tail-feathers are raised, and the two spatules are brought together. A curious habit of this species is the following. Two young males arrest themselves in the air facing each other with their bodies suspended vertically, opening their tails from side to side, so that the lengthened rectrices form a straight line to the axis of the body, and throw themselves from one side to the other. Every time the birds open their tails a low sound is heard similar to that caused by striking two finger-nails together, or the snap produced by shutting the lid of a watch. The two lengthened under tail-coverts always remain in their normal position. This manœuvre is kept up for about twenty seconds. Ordinarily only two young males engage in these actions, but when they make much noise several take part, and always the voice of the female can be heard in the vicinity. Another still more curious habit, as narrated by Stolzmann, was practised by the young males. One would suspend himself beneath a small branch, whilst another manœuvred above him, spreading the tail and making the low click; then in a twinkling of an eye, the rôles would be changed and the upper would suspend himself, and the other would take his place. What these evolutions mean is unknown. The adult males rarely practise them, though they often pass when the young males are engaged in this manner. Sometimes the old males by spreading the tail give a peculiar position to the external rectrices by placing the spatules above the head. Once Stolzmann observed an adult male drinking from a brook. He had chosen a little cascade, and it is from these alone that it is pretended the birds are able to quench their thirst. The male of this extraordinary species has the crown of the head a brilliant sapphire blue; upper parts golden green; throat brilliant green, tinged with blue in the centre, and surrounded by a narrow band of coppery-red, this bordered by black; sides of breast and flanks dull white; middle of breast velvet black with a coppery tinge. The lengthened under tail-coverts are bronze green on their basal half, passing into a blackish-blue, and white at their tips. Bill, black; feet, brown; tarsus covered with white feathers; iris, nearly black.

The genera *Steganura* and *Discura* have together seven species, birds with luminous throats and breasts, and elongated external rectrices bare of webs near the tips, and terminating in a spatule. The members of the first genus also have the tarsi completely hidden in downy puffs. They dwell in various parts of South America, all but two, however, being natives of the western side from Columbia to Bolivia. *Steganura solstitialis*, from Ecuador and Peru, is found at altitudes of from 3700 to 8000 feet above the sea level. It is easy to be distinguished from other humming-birds by its voice, as it possesses certain harmonious notes. It has a steady flight, and does not precipitate itself from flower to flower with the suddenness so characteristic of some of its relatives. When resting it perches on low branches, but when flying it frequently rises to such a height that it is difficult to see it.

Gouldia contains four species, remarkable for their singularly shaped tails, which are composed of lengthened attenuated feathers, the three outer ones on either side being the longest, although very unequal, and the four median ones being so short as to be hardly visible. *G. letitie* is, in the coloring of its plumage, almost exactly like *Discura longicauda*, but does not possess the spatules at the end of the external rectrices. They are most charming little creatures, the heads and breasts covered with metallic green feathers, this, in one species, bordered with red beneath the green on the breast; and *G. poplairii*, from Colombia, Ecuador and Peru, has the head ornamented with a crest terminating in lengthened, hair-like feathers.

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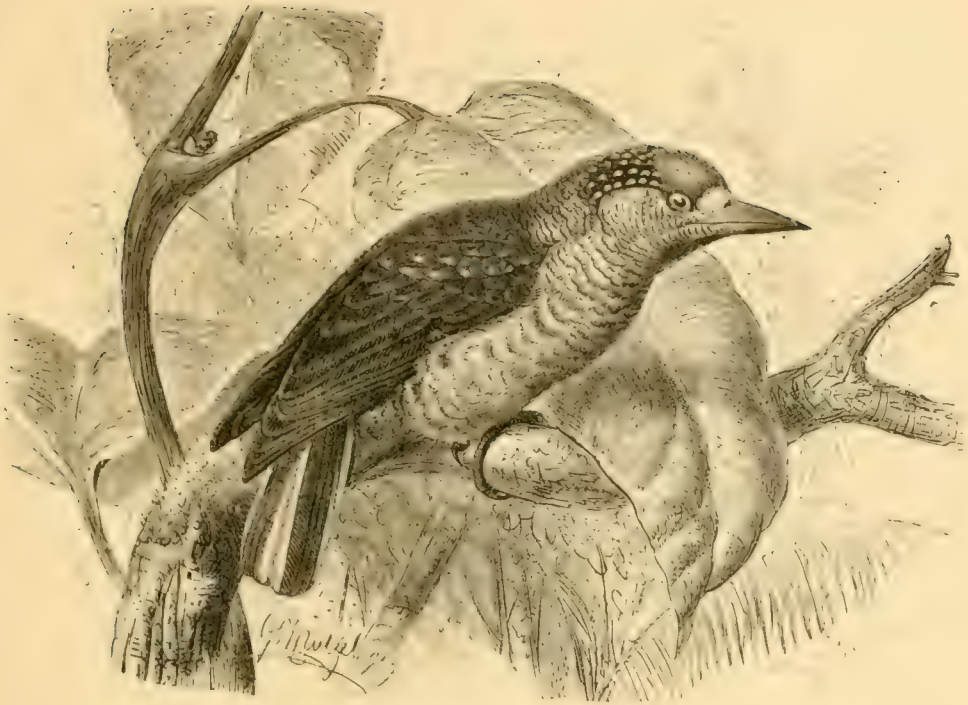
Serinus canarius, wild canary.



Cardinalis cardinalis, cardinal grosbeak, and *Habia ludoviciana*, rose-breasted grosbeak.



Rhein rhea, avestruz, nandu, South American ostrich.



Picumnus lepidotus, piculet.



Picoides tridactylus, three-toed woodpecker.



Mniotilta varia, manakin.

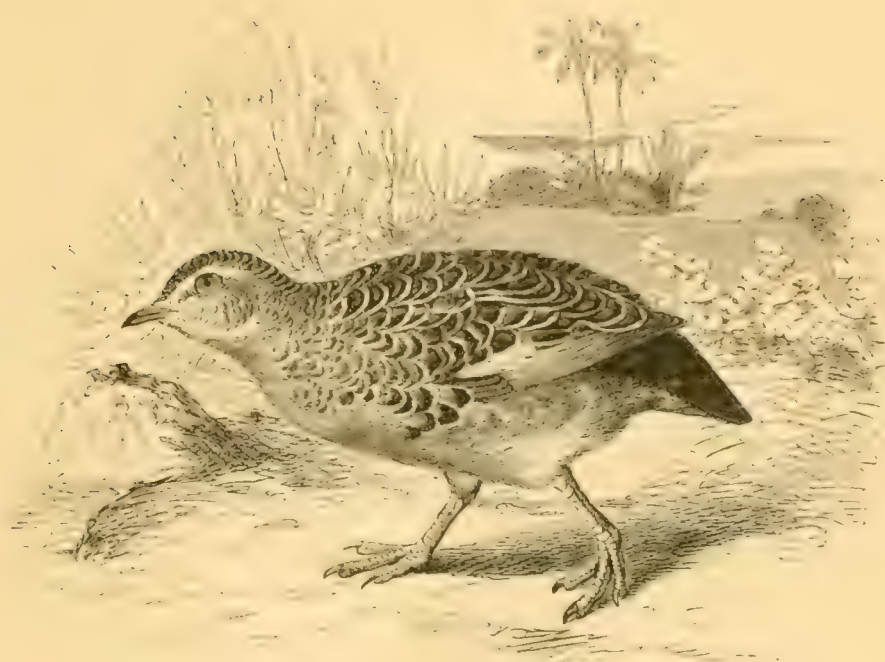


Rupicola rupicola, cock-of-the-rock.



BIRDS-OF-PARADISE.

1. *Paradisea apoda*, great bird-of-Paradise; 2. *Parotia sefilata*, six-shafted bird-of-Paradise;
3. *Cicinnurus regius*, king bird-of-Paradise.



Turnix sylvatica, torillo.



Coturnix communis, migrating quail.



Agrobates galactotes, rufous warbler, and *Sylvia orphea*, Orphean warbler.



Cyanecula svecica, blue-throat, and *Melodes calliope*, Kamtschatkan nightingale.

The species of the genus *Lophornis* are also small birds, with a highly ornamented plumage, and have elongated feathers with metallic tips, springing from the sides of the neck. Some also are adorned with crests, and all save two have metallic throats. There are nine known species of this genus, and they bear the common name of 'Coquettes.' They are found in Central America, Trinidad, and northern and western South America. The most beautiful of these birds, if one can discriminate where all possess so many attractions, is probably *L. helene*, from Mexico, Guatemala, and Costa Rica. Beside a dark metallic green crest, there are three long, slender, greenish-black feathers springing from either side of the occiput. The throat is metallic green surrounded with black, the feathers on the sides of the neck elongated and streaked with buff. Another beautiful but very differently colored species is *L. ornatus*, from Trinidad, Venezuela, and Guiana. It has the forehead and throat metallic green, rest of head and crest chestnut, unspotted. On either side of the neck is a series of lengthened graduated feathers, each one tipped with metallic green. This bird seeks its food from the flowers in more open parts of the country than in forests, and builds a round, cup-shaped nest, composed of some cottony material, bound together with cobwebs, and decorated externally with mosses, lichens, etc.

Tilmatura contains only one species, with a remarkably-colored forked tail. This has the median rectrices short, and shining green; next one, dark brown; next, also, dark brown, but with a white spot on inner web, and a white tip; the remainder is dark brown at base, then a band of rufous, then one of white, succeeded by another of dark brown, and the tips white. This bird is a native of Guatemala, frequents the gardens and other places where flowers abound, and builds a beautiful little round nest of vegetable fibres and thistle-down, thickly covered externally with small pieces of lichens, attached by means of cobwebs. It is fastened to any small branch, such as that of a rose-tree, etc.

Chatocercus, *Acestrura*, and *Calothorax* are represented by species, some of which are among the most minute in the Trochilidæ. They have very peculiarly shaped tails. Those of the members of the first genus have the median rectrices extremely short; two next the outermost ones lengthened, equal and uniform; outermost one half the length of the one next it, filiform and stiff, graduating to a point. *Acestrura* has the two outer rectrices almost bare of webs, and spine-shape; while the species of *Calothorax* has the outermost rectrix of a similar shape. There are about nine species in these genera, natives of Mexico and the northern and western side of South America. *Chatocercus bombus*, two and a half inches in length, is not much larger than a honey-bee. It is a native of Ecuador and Peru, dwells at an elevation of from five to nine thousand feet, flies in a straight line but not so rapidly as some other humming-birds, and when perched on a branch elevates and depresses the tail as if balancing itself. The males have frequent combats, and sometimes one will mount upwards until its tiny body has completely disappeared from sight.

Heliactin, with its single species, *cornutus*, is an aberrant form among the Trochilidæ, and is chiefly noticeable for the brilliant tufts or 'horns' on each side of the head. It is a native of Brazil, and, although long since described, very little is known of its habits. The 'tufts' are fiery crimson at base, changing to greenish yellow at the tips, very brilliant in color, and a great ornament to the bird.

We now come to a section of the Trochilidæ composed of the genera *Stellula*, *Athis*, *Catharna*, *Selasphorus*, *Calypte*, and *Trochilus*. They are all birds of moderate or small size, all with brilliant metallic coloring on their throats, this sometimes ex-

tending to and including the head. They have short tails and bills, and in general appearance are most attractive birds. *Selasphorus rufus*, from California to Nootka Sound; *Calypte annæ*, from Mexico and California; and *Trochilus colubris*, the Ruby-throat, of eastern North America, south to Central America and the West Indies, are probably the best known among the species. A charming species is *Calypte helena*, from Cuba. The entire head and throat with its lengthened feathers are brilliant metallic crimson, and the tail deep greenish blue, as are also the upper parts;



FIG. 223. — *Helactin cornutus*, horned hummer, sun-gem.

under surface white. This little gem, of only about two and a half inches in total length, has a varied song, well sustained, and, for the size of the little creature, rather powerful. It has not a rapid flight, is very pugnacious, and when in the air preserves a complete silence, but commences to sing on alighting.

Mellisuga minima, from Jamaica and St. Domingo, is among the very smallest of birds, being only a little over two inches in total length. This diminutive creature is rather plainly attired, being green above, and white beneath. It is quite abundant in Jamaica, resorting to the blossoms of the West Indian vervain, seeking its nourish-

ment precisely in the same manner as the honey-bee. In the spring months soon after sunrise it sits on the top of a mango or orange tree, and warbles a melody in a weak but sweet tone, for minutes at a time. The nest is a cup, formed of silk cotton, ornamented outside with gray lichen. The movements of this bird's wings in flight are so rapid that they produce a sound like an insect's hum. *Thalurania* contains eleven species of moderate size and graceful forms, with a plumage of green or green and blue, with metallic hues on the crown and throat, and sometimes on both. They have a wide distribution from Central America to Peru.



FIG. 224. — *Topaza pella*, topaz humming-bird.

Aithurus contains a very singular species from Jamaica, *A. polytmus*. It is one of the longest known members of the family, and is conspicuous from the fact that the lateral rectrices next to the outermost one on either side are nearly three times longer than the other feathers, and are curved, and cross each other near their centre. The head also has a somewhat lengthened black crest. It is very common in Jamaica, where considerable numbers may be seen at one time performing their aerial evolutions, chasing each other, or feeding from the various flowers. They do not always probe these when on the wing, but may be seen thus engaged when sitting near them on the branch. The nest is composed of silk cotton, the outside quite covered with spider's webs, and bits of lichens and bark stuck in here and there. The eggs are oval

and when fresh have a reddish tinge from the thinness of the shells. The general color of the plumage is green, from a dark shade to lustrous emerald.

Topaza contains two gorgeously colored large species with peculiarly formed tails, which are rounded, the feathers on either side of central pair narrow and elongated far beyond the rest, and crossing each other. *T. pella*, an inhabitant of Cayenne, Trinidad, and Brazil, is something of a recluse, dwelling in the heart of the forest near to rivers or lonely and dark creeks. He comes out of his retreat before sunrise, but returns as soon as the bright rays have lit up the landscape, coming out again just after sunset. The nest is deep, of a cup-shape, formed of a kind of fungus resembling tinder, and united by cobwebs or similar material. The male is very beautiful, having the back shining red changing to orange-red on the rump; the throat metallic greenish-yellow with a topaz hue in the centre; the rest of lower parts are shining crimson; upper tail-coverts light bronze-green; the under coverts golden-green; middle rectrices bronze-green, next two dark purple, remainder reddish-buff; the head, bill, lores, and line encircling the throat, black. The genus *Eustephanus* contains three species, from Chili and the islands of Juan Fernandez and Masafuera. They are large birds, the metallic hues of their plumage being confined to the top of the heads. In two species the females possess an entirely different dress, and from the fact that their crowns were also metallic, for a long time it was supposed they represented distinct species.

Hemistephania, *Bourcieria*, *Helianthea*, and *Diphlogana*, all contain beautiful species, some of them being among the most brilliantly colored of the Trochilidæ. They are almost all large birds, with long lance-like bills, and for the most part dressed in shining hues of lustrous metallic colors. *Bourcieria inca* from Peru and Bolivia may be selected as representing one type of beauty. This lovely species has a jet-black head, with a luminous metallic emerald-green spot in the forehead, which shines like a brilliant star in the midst of its sombre surroundings. A broad band of deep buff crosses the breast and covers the sides of the neck; rest of plumage glittering metallic grass-green, and bronzy-green, most brilliant in certain lights. The lateral rectrices are white, tipped with bronzy-green. This bird is found on the eastern slope of the Andes, at an elevation of 10,000 feet, and resorts to a shrub bearing red wax-like flowers. It visits every flower in succession, never passing by a single one, is very conspicuous on the wing, and has a very rapid flight. Beautiful, however, as is the bird just described, it is far surpassed in the splendor of its decoration by the *Diphlogana iris* and *D. hesperus* from Ecuador, Peru, and Bolivia. These marvellous creatures have the forehead metallic golden-green, changing to a metallic orange-scarlet on the sides of the crown, with the centre of the latter metallic-blue; occiput velvety-black; throat and breast glittering grass-green, with a spot of purplish-blue in the centre. The rest of the plumage is chestnut red. It is almost impossible to conceive a more exquisitely beautiful bird than are these species. They live at high altitudes 7000 to 9000 feet, not very rare in certain localities, and visit chiefly a certain kind of orange flowers or the purple blossoms of *Iochroma*. Sometimes they will take up a position upon some dry branch, and launch themselves forth at intervals and catch insects upon the wing. The single species of *Docimastes*, *D. ensiferus*, is remarkable for the length of the bill, which exceeds that of the entire bird. The necessity for this is at once understood when the lengthened tubular flowers of the *Brugmansia* are seen, from the bottom of which the species procures its food, and which could never be reached by a short-billed bird. When flying it presents a

curious appearance, the bill being so disproportionately long to the size of the body, and it stops before a flower as though examining the interior, and then suddenly thrusts in the long bill, repeating the action at various intervals. It takes long flights, and other humming-birds keep out of its way, none daring to attack it, afraid probably of the long bill, which would doubtless make this bird a formidable antagonist. It is of rather dull plumage, the sides of the breast alone being a bright luminous green.



FIG. 225. — *Docimastes ensiferus*, sword-billed humming-bird.

Patagona and *Pterophanes*, containing each a single species, the giants of the Trochilidae, are the largest known forms. They are denizens of the Andean range from Colombia to Chili. *Patagona gigas* is the largest species, a dull brownish-colored bird, not unlike some snipe in general appearance. Its flight resembles somewhat that of the martin, often, though, keeping the wings immovable. It has a habit of darting into the air, striking the wings together, and then returning to its place.

Beside a delicate whistle it emits no sound. *Pterophanes temminckii* has a flight very similar to the last species, and moves the wings slowly showing the blue coloring to great effect. It has been observed at elevations of 13,000 to 14,000 feet where there are no flowers, sweeping along the grass searching for insects. The skin has a musky smell, strongest when the bird is in the flesh. Once one was observed to attack a large hawk and drive it away from its feeding grounds.

Heliodoxa, *Lamproaster*, *Eugenia*, *Urochroa*, *Eugenes*, *Sternoclyta*, *Iolama*, *Clytolama*, and *Phæoloma* are a group of genera with species more or less related to each other. They are generally birds of large size, many of very brilliant coloration, with rather long stout bills, and, as a rule, with the feathers of the forehead projecting onto the culmen and covering the nostrils. *Iolama whitelyana* is a very fine species with all the upper surface deep grass-green, and a glittering spot on the forehead. The under parts are jet black, save a broad band of violet on the throat. It is found at Cosnipato, Peru, and frequents the flowering plants at the tops of the highest trees in the depths of the forest, keeping nearly always out of gun-shot. It has a very powerful flight, and goes from flower to flower with wonderful rapidity. Another more beautiful bird is *Eugenia imperatrix*, from Ecuador, with the forehead and chin brilliant metallic green, upper parts grass-green, exceedingly luminous when viewed from behind, and a metallic violet spot on the throat. This handsome bird inhabits the thick forests at about four thousand feet of elevation, and feeds from the beautiful flowers of an *Alstræmeria*, which hang from the extremity of this twining plant. The genus *Panoplitës* contains three species clothed in brilliant metallic colors, agreeing in having their upper parts green, but their under parts are clothed in strongly contrasted colors of diverse hues. Perhaps the most brilliant of the species is *P. jardi*, from Ecuador, with the crown and under parts shining violet blue, and the upper parts metallic bluish-green. The *P. matthewsi* is very different, having the under parts deep chestnut-red, and upper parts metallic golden-green. This is said to be a most pugnacious species, and when an individual alights upon a tree he will not permit any other humming-bird to approach the flowers upon it. They hurl themselves against each other in the air like cocks, and pursue all others of the tribe in their vicinity. It is met with as high as 10,000 feet above the sea, and its flight is short, the bird frequently perching.

Petasophora includes another small group of very different appearance from the last. Of rather large size, and greatly resembling each other in plumage, the species are distinguished by their metallic-blue ear-coverts, metallic-green scale-like breasts, and broad bluish-green barred tails. The *P. anais* feeds upon insects which it seizes in the air, in the most agile manner, snatching them in all directions, executing at the same time most graceful movements. At times it launches itself into the air from its perch, sings a short simple song, and returns like an arrow to its original position, repeating this several times but always returning to this same place. It lives at altitudes varying between 5,000 and 9,000 feet. Two birds with pure white tails tipped with purplish-brown form the genus *Florisuga*. In general form they resemble the next genus, *Chalybura*, the members of which differ from all known humming-birds by the great development of their plume-like under tail-coverts, which peculiarity exists in both sexes. The males are clothed in green, most luminous on the lower surface, one species being an exception, and having this part blue. The lower tail-coverts are white except in one species which has them black. They are natives of Central America, Venezuela, and Columbia.

The genera *Eulampis* and *Lampornis* are closely allied, with green and black the principal hues of their plumage, sometimes varied with blue, the metallic colors chiefly confined to the throat and breast. The species of *Eulampis* in addition to other characters possess luminous upper tail-coverts causing them to be very conspicuous objects. The birds of these genera inhabit Mexico, Central America, West India islands, and portions of eastern South America.

Oreotrochilus is a genus of hummers that dwell in lofty altitudes just beneath the line of perpetual snow. Some of the species are entirely confined to particular



FIG. 226. — *Oreotrochilus chimborazo*, Chimborazo humming-bird.

mountains, like *O. chimborazo* and *O. pichincha*, which are found upon the volcanic peaks whose names they bear and that of Cotopaxi. The last named feeds frequently from the ground, hunting the moss-covered clumps for insects, as the snow melts away. When the plants of those Alpine heights are in bloom, they frequent the flowers. Another species, *O. leucopleurus*, is said to live in the most elevated Andean valleys, amid storms of rain, hail, and thunder, in places where a species of this family would be least expected. It subsists mostly upon insects, small flies chiefly contributing to its support. They are handsome birds with the under parts white, deep chestnut, or black, with metallic-colored throats, some with richly colored heads.

The genera *Campylopterus*, *Sphenoproctus* and *Eupetomana* are composed of species characterized by having the shafts of the primaries more or less developed, and greatly flattened in the males. The majority of the species have a portion of their plumage adorned with metallic coloring. The genera are distinguished mainly by the shape of the tail of the various species, this being rounded, cuneate, or deeply forked, in the order of the genera named. A very large and showy species is *Campylopterus hemileucurus*, with the upper and under surfaces metallic violet-blue, a black tail glossed with green, the outer feathers largely tipped with white. It is extremely



FIG. 227. — *Eutoxeres aquila*, sickle-billed humming-bird.

pugnacious, two males rarely meeting without a combat. This generally commences with a sharp shriek, then, with dilated throats and feathers all on end, they fight until one falls to the ground or escapes by flight. The chief damage done in these combats is the splitting of the tongue of one of the contestants, which then surely dies, being no longer able to feed.

One of the most extensive genera of the Trochilidæ is *Phaethornis*, embracing about twenty-two species. The majority of these are plainly attired without any metallic coloring, and all are chiefly remarkable for their peculiarly shaped tails, the middle feathers of which extend beyond the rest, and are always longest in the

females. The plumage consists of green, gray, buff, or whitish, and the species for the most part dwell in dark and gloomy situations in the interior of the forests, feeding upon spiders and other insects which they capture on the under side of the leaves of great trees, or in the crevices of the bark. Their movements on the wing are very graceful, the beautifully formed tail being exhibited to much advantage.

The birds of the genus *Eutoxeres* are distinguished for their very remarkable bills, which are decurved so as to form nearly one third of a circle. They are of rather large size, with very little metallic coloring, the plumage being of usually sombre hues, the throat and breast striated with buff. The tail is cuneate, with pointed feathers. The unusual and peculiar form of the bill is explained when the shape of the flower from which the bird feeds is seen. This is of the shape of a Roman helmet inverted, attached to the stalk by the point of the crest as it were. The bird inserts the bill into the calyx, not by advancing in a direct line to the flower as is usually done, but by first stooping forward until the bill is introduced, and on the point reaching the desired locality, the body is dropped down so that the bird appears to be hanging by the bill. After remaining in this position a moment, by reverse movements to those described, the bill is withdrawn. These birds fly swiftly, with a loud hum and buzzing of the wings. Three species only are known, natives of Central America, Colombia and Ecuador.

D. G. ELLIOT.

ORDER XVIII.—PASSERES.

This order comprises in round numbers say six thousand species, or more than half the number of all the known birds. In the foregoing pages of this volume, consequently, we have dealt with a less number of species than this order alone contains. The great majority of the Passerine species, however, are so closely allied that it is only in catalogues and nominal lists that they take up the greatest space; while here, where we have to consider the forms according to their biological and morphological features, the present order will receive a treatment commensurate with the importance of the group in these respects, but not with the number of the species.

There seems to be no single character by which the Passeres, as here and most commonly defined, can be separated from all the rest of the birds. Hence the only characteristic which can be formulated in a few words is that they possess a number of characters which are not combined in the same way in any bird included in the foregoing orders. It is especially among the Picarians that we find forms which approach the Passeres very closely in some of their characters, while, on the other hand, a few generalized Passerine birds have retained some ancestral peculiarities which link them to the groups below.

We have seen that agithognathism is no exclusive character; in most Passeres the manubrial process of the sternum is bifurcate, but it is so in some higher or passeri-

form Picarians; the hind margin of the breastbone has mostly only two notches, but in a few has four, and in some Picariæ has also only two; the Passeres have cæca and no tuft to the oil-gland, but many Picarians are similarly characterized; the Passeres have a peculiarly specialized arrangement of the wing-coverts, a feature already noted on a previous page when we said that woodpeckers and some allied forms present the same kind of specializa-

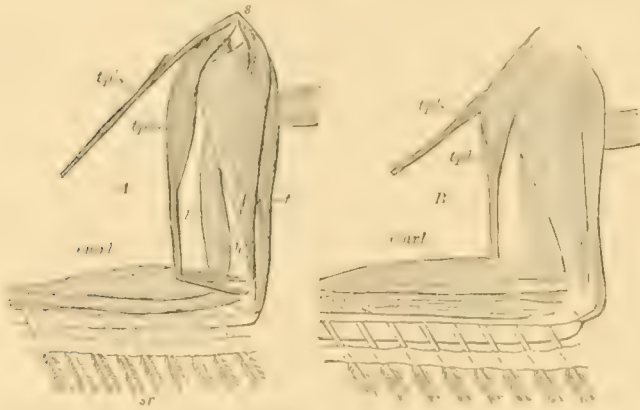


FIG. 228.—Diagram of the elbow-muscles in (A) *Icterus* and (B) *Menura*; muscles with long tendons with transverse line. *t*, triceps; *carl*, extensor metacarpi radialis longus; *h*, humerus; *s*, shoulder; *sr*, secondarily tendons; *t*, triceps; *t'*, tensor patagii brevis; *t''*, tensor patagii longus.

tion. The schizopelmous arrangement of the deep plantar tendons would have been an excellent distinction but for the fact that the hoopoes are also schizopelmous, while the Eurylaimidæ, which are otherwise true Passeres, have the flexor hallucis attached to the perforans digitorum by means of a strong vinculum, making them desmopelmous. Another myological feature which is peculiar to the Passeres inasmuch as it does not occur in other birds, though not in all Passeres, is the distal insertion of the tensor patagii brevis, a muscle which has already been mentioned under the head of the Micropodoideæ. Being obliged to treat of this character more in full, we shall try to use Professor Garrod's own words whenever possible.

In the patagium, that is the triangular membrane of the bird's wing expanded between the anterior margins of the humerus and the fore-arm, the tendons of two muscles are to be found. One is that of the *tensor patagii longus*, which forms the supporting chord of the free margin itself. The second is that of the *tensor patagii brevis*, which courses parallel with the humerus from the shoulder to the muscles and fasciæ of the fore-arm. From the comparatively insignificant fleshy belly of this muscle, a single cylindroid tendon runs to the upper margin of the axially running tendon of origin of the *extensor metacarpi radialis longus*, at a point not far from the tubercle on the humerus, whence this muscle springs. In most of the Passeres the *tensor patagii brevis* here becomes attached to the latter muscles without blending with its tendon, and runs from the point of attachment back, independently fixing itself to the base of the same tubercle as the *extensor m. r. longus*, as a consequence of which arrangement two distinct tendons run to that same spot, as may be plainly seen in the accompanying cut (Fig. 228 A.) In a few Passeres of the South American families Pterotochidæ and Conopophagidæ, the arrangement is a little obscured since the muscular fibres of the *extensor m. r. longus* almost surround and enclose the tendons in question, but upon removing these covering fibres the two tendons are seen arranged exactly as in most other members of the order. The only real exceptions are the lyre-bird (*Menura*), and the Australian brush-bird *Atrichornis rufescens*, in which the *tensor brevis* inserts itself on the tendon of the *extensor metacarpi*, in such a way as to blend with it entirely, only one tendon running to the tubercle at the elbow, an arrangement which is exactly like that of the Ramphastidæ, Megalaimidæ, Indicatoridæ and Picidæ of the foregoing order, and illustrated in Fig. 228 B.

A certain structure of the syrinx is also peculiar to the Passeres, although not common to all of them. Having already in the introduction to this volume promised a fuller account of this feature, we shall try to make this point as intelligible as possible, especially since the syringeal arrangement has been made the chief character by which some systematists primarily subdivide the Passeres.

The great German anatomist, Johannes Müller, in 1846 announced the discovery that the Passerine birds exhibited two—or rather three—radically different types of the lower larynx. He found that in the vast assemblage of birds which has usually been called Oseines, Cantores, etc., the intrinsic muscles—numbering from two to six pairs—are inserted into the extremities of the bronchial semi-rings, an arrangement which Garrod has termed *acromyodous*, while

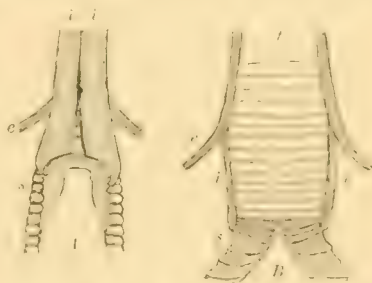


FIG. 229. — Syrinx (A) of *Atrichornis* (acromyodous) and (B) of *Heterosyrinx* (mesomyodous); m, intrinsic muscles; s, bronchial semi-rings; t, trachea; the muscles are lined longitudinally.

the rest have these muscles—usually only one pair—attached to the semi-rings in their middles; these are called Mesomyodi, or Clamatores. But of the latter some South American forms are peculiar in having the syrinx chiefly formed by the lower end of the trachea, hence Müller made them a separate group, Tracheophonæ; the Mesomyodi with tracheo-bronchial syrinx are often termed Oligomyodi, or Haploophonæ, though the latter name was originally intended for a more restricted group. The terminology is somewhat intricate, but it is important that one who wishes to study or understand the modern schemes of Passerine classification should master it thoroughly, hence Fig. 229 is given to indicate the difference between the acromyodian and the

mesomyodian type, A representing the former, B the latter. The aeromyodian form here figured is not quite typical oscinine, but the attachment of the intrinsic muscles to the ends of the semi-rings is well represented, while the median insertion is equally plain in the other figure.

The classification of the Passeres has recently made a long stride forward, especially by the investigations of Professor Garrod. We have above indicated three primary divisions of the order, which we shall designate as super-families, to which we may add two additional ones, the Eurylaimoideæ, and the Menuroideæ; the three others are the Tyrannoidæ, corresponding to the non-tracheophonous mesomyodians, the Formicaroidæ, being the equivalent of the Tracheophonæ of authors, and the Passeroideæ, of the same limits as the Oscines proper, or the Acromyodi of Garrod, minus the Pseudoscines of Selater. These five super-families to be arranged as follows:

Tensor patagii brevis picarian			<i>Menuroideæ.</i>	
		syrinx broncho-tracheal	<i>Eurylaimoideæ</i> ;	desmopelmous.
			<i>Tyrannoideæ</i>	
Tensor patagii brevis passerine {	mesomyodian	{	syrinx tracheal	<i>Formicaroidæ</i>
	acromyodian			
			<i>Passeroideæ</i>	schizopelmous.

On the whole the MENUROIDEÆ may be regarded as the most abnormal Passeres, and in many respects most generalized. It is true that their syrinx is 'aeromyodian,' inasmuch as the intrinsic muscles are fastened to the ends of the semi-rings, but there seems to be nothing to necessitate the theory of the true oscinine syrinx having been developed from this 'pseudoscinine' one, or to prevent the assumption that both these styles have developed independently from the mesomyodian pattern, as they are sufficiently diverging in other points than the number of the intrinsic muscles to make it probable that they are of independent origin. It is also true that they are schizopelmous, and that the Eurylaimoideæ, which we have placed after them, are more generalized in this respect, being, as they are, desmopelmous; but there is nothing strange in supposing that the vinculum has been lost independently in the birds of the present group and in those of the three last super-families of our scheme; in other words, that the vinculum was lost by the ancestors of this super-family and in those mentioned after the ancestral passerine stock had split into two groups, characterized by the difference in the arrangement of the *tensor patagii brevis*, besides in several osteological features. The proof of the admissibility of this conclusion is furnished by the fact that not only has a Picarian group — viz., the hoopoes — developed the same arrangement of the deep plantar tendons, but that even several herons have lost the vinculum connecting the *flexor hallucis* with the *flexor perforans*.

The osteological features by which the members of the present super-family deviate from the other Passeres are many, but we shall only mention those by which the two families which constitute the super-family may be at the same time separated. The lyre-birds have quite a peculiar breast-bone, it being long, and much constricted near the centre; the manubrium is very well developed and furcated; the posterior edge is strongly convex, and has only a slight notch on each side near the margin, quite different from all other Passeres. The clavicles are well developed, but without a median process at the symphysis. On the other hand, the sternum of the brush-birds, as figured by Garrod, differs very much from the above. The manubrium is less developed, though furcate, and the posterior edge is straight, with a deep passerine notch

on each side; but the most curious feature is the absence of clavicles, of which only a small rudiment is left, a feature absolutely unique amongst Passeres.

The lyre-birds, therefore, constitute the family *MENURIDÆ*. Their chief internal characteristics have already been mentioned; we shall only add that, notwithstanding Professor Huxley's assertion to the contrary, maxillo-palatines are present, being long and slender, and separate from one another and from the vomer, and that the syrinx is supplied with only three pairs of intrinsic muscles. Externally these birds are not less remarkable, as will be seen from the accompanying cut. They are rather large birds, the body equalling in size that of a ruffed-grouse; the head is small, the



FIG. 230. — *Menura superba*, lyre-bird.

tarsi are very long and stout and the toes are provided with long and rather straight claws. The above characters, except the last one, in connection with the unique tail, give these Australian birds quite the aspect of one of the Gallinaceous order, with which, indeed, some earlier ornithologists placed them, and the colonists in New South Wales call them 'pheasants' to-day. The beautiful tail of the male is composed of the unusual number of sixteen rectrices, which are enormously lengthened and gracefully curved, so as to imitate the shape of a lyre when raised. When the bird is singing the tail is displayed in the same manner as a peacock spreads his train. The color of the lyre-bird is a sombre dusky, in several places tinged with rufous, and there is nothing particularly attractive about it beyond its unrivalled tail.

Two species only are recognized in the genus *Menura*, the only one constituting

the family, both very similar in appearance. In contradistinction to the species here figured (*M. superba*), the *M. alberti* is of a more rusty color, and has the outer lyre-shaped tail-feathers much shorter and entirely destitute of bars.

The lyre-birds are very partial to the dense brush, and are said to be very shy and difficult to approach. In some parts of New South Wales they are sometimes successfully pursued by dogs, which by their barking attract the attention of the birds so that the hunter may easily approach. The birds rarely, if ever, attempt to escape by flight, but easily elude pursuit by running swiftly over the ground in the dense brush. The lyre-bird is credited with a great power of mocking the song of other birds or the voices of other animals, even the barking of the dingo. Mr. Gould also states that they are of solitary habits, and that they form small round hillocks, which are constantly visited during the day, and upon which the male is continually trampling, at the same time erecting and spreading out its tail in the most graceful manner. Mr. A. A. Leycester says that the Albert lyre-bird generally constructs its nest of small sticks, interwoven with moss and fibres of roots; it is covered in with the entrance on the side, and placed on the side of some steep rock. The single egg laid is of a very dark color, appearing as if it had been blotched over with ink.

The *ATRICHORNITHIDÆ*, brush- or scrub-birds, constitute a family of pseudoscinine, acromyodian Passeres, with two pairs of intrinsic muscles. They are not more numerous than the lyre-birds, comprising only one genus of two species, which also are exclusively Australian in their distribution.

Their external appearance does not indicate any close relationship with the lyre-birds, for in size and general form and coloration they more closely resemble some of our large wrens, with long graduated tails. Their habits are not unlike those of the lyre-birds, and their power of mocking other sounds is equally strong. From Mr. E. P. Ramsay's account of the habits of the species discovered by him, *Atrichornis rufescens*, we quote as follows: "Only on one occasion did I meet with more than a single bird in the same place. They are always among the logs and fallen trees, overgrown with weeds, vines, nettles, etc., and are the most tiresome birds to procure imaginable. As to their ventriloquial powers, *they must be heard to be believed*. It is impossible to say what its own note really is. I have frequently stood on a log waiting for it to show itself from among the tangled mass of vines and weeds at my feet, when all of a sudden it would begin to squeak and imitate first one bird and then another, now throwing its voice over my head, then on one side, and then again apparently from the log on which I was standing. This it will continue to do for hours together; and you may remain all day without catching sight of it."

The broad-mouths, forming the super-family *EURLAIMOIDEÆ*, which again only comprises one family, the *EURLAIMIDÆ*, recall in their external appearance several Picariæ, for instance, rollers and barbets, and in fact were usually kept with that order in the systems until more recently Sclater, Garrod, and Forbes demonstrated their passerine nature. Particularly convincing is the absence of tufts to the oil-gland, combined with presence of cæca, the nature of the pterylosis, and the insertion of the *tensor patagii brevis*; the palate and the posterior margin of the breastbone are also typical passerine, but the manubrium is pointed and not bifurcated. The desmopelמוש arrangement of the deep plantar tendons, which prevents the hallux from being moved independently of the other toes, is another picarian feature. Johannes Müller denied the existence of intrinsic muscles to the syrinx in the only species examined by him, but this may have originated in a mistake, for in others one

pair of slender muscles is present, and the syrinx is altogether constructed after the tracheo-bronchial mesomyodian pattern.

The present family is confined to the southeastern part of the Oriental region, a few species occurring from the Himalayas southwards through Burmah and Malacca to the islands of Sumatra, Java, and Borneo, representing in the Old World their allies, the cotingas and pipras of South America. Owing to the small number of species—hardly a dozen—belonging to not less than five genera, the group proves itself to be on the way to extinction, the last remnants of a once probably quite numerous group. We have here an excellent illustration of the fact that the distinctness of the different groups of our systems only depends upon the number of links that have disappeared. Had hoopoes and broad-bills become extinct only a short time before the present era of anatomical ornithology, the systematist would have found no difficulty in trenchantly defining the 'order' Passeres.

The broad-bills are rather small birds, not much larger than sparrows, with somewhat syndactyle feet, the outer and middle toes being connected for a distance of nearly two joints. The bill is very broad, and remarkably resembles that of some rollers, while in coloration and extreme sluggishness and stupidity they remind one of the barbets. In regard to color, the likeness between *Pogonorhynchus dubius*, from Africa, as described in a previous page of this work and the blue-billed gaper (*Cymbirhynchus macrorhynchus*) is very striking. The latter bird is found in Sumatra and Borneo, while a nearly related form, *C. malaccensis*, is common in Malacca, where Lieutenant II. R. Kelham recently has observed its interesting breeding habits, and from his account we choose the following abstract: "Kwala Kanysar, Perak, 5th May, 1877.—This afternoon, while stalking jungle-fowl, which towards dusk come out to feed along the outskirts of the jungle, I saw a blue-billed gaper fly out of a large, roughly-made, domed nest, which was hanging from the top-most twigs of a slender sapling, at about ten feet from the ground; over the entrance, which was on one side, a kind of roof projected, like the slanting shade of a cottage-door. Internally the nest was rather neatly lined with flags and green leaves, and contained four white eggs, one and one twelfth inches long by eight twelfths broad, blotched (principally at the larger end) with rusty brown marks." The bill of the present species is of the most pure cobalt blue above and orange below, while the eyes are emerald green.

Before leaving this family we may mention the beautiful green *Calypomena viridis*, from Borneo, Java, and Sumatra, which, from its rounded crest on the head and other external peculiarities, has been classed by some authors with the South American cock-of-the-rock (*Rupicola*). The internal structure, however, shows plainly that it belongs to the same family as its countrymen, the broad-bills.

The birds composing the super-family TYRANNOIDEÆ have already been defined as Passeres with a mesomyodian tracheo-bronchial syrinx, and with the hind toe independently movable. It is a rather large group which, in regard to the disposition of the vessels of the thigh, has been divided in two groups, Homœomeri and Heteromeri. In the former the main artery accompanies the sciatic nerve, as in nearly all other birds, while in the latter the femoral artery is the main artery of the thigh. This exceptional arrangement is found in the pipras and cotingas, with the exception of the cock-of-the-rock, which seems to prove that the character is not one fit to base even a family division upon.

The horny covering of the tarsus still plays a great rôle in the classification of the

Passeres, and, as the present super-family contains a great many different forms of tarsal scutellation, we may improve the opportunity by familiarizing ourselves with a few of the modern technical terms, which in one word express quite marked differences.

The first distinction to be made is between a *scutelliplantar* and a *laminiplantar* tarsus. In the former, at least one of the sides of the posterior tarsal surface is divided by transverse sutures or is broken up into small scutellæ. The laminiplantar tarsus is covered behind with a continuous horny lamina on each side, without sutures or divisions. This arrangement is found in all true Oscines (Passeroideæ) with the exception of the larks, and is only met with in a few Old World forms of the present super-family, viz., in the Pittidæ, which also have the tarsal covering in front undivided, or 'booted' (*ochreateæ*).

The scutelliplantar tarsus shows several modifications. The anterior scutes may extend round to the posterior margin exteriorly, leaving the internal plantar space covered by a smooth skin, with no signs of scutes or scutellæ; such a tarsus is said to be *exaspidean*. Or the arrangement may be reversed, so that the anterior scutes are extended round the tarsus on the inner sides, in which case it is *endaspidean*. If the posterior surface of the tarsus is entirely broken up into numerous small, somewhat irregular and rounded scutellæ, the tarsus is *pycnaspidean*, while *taxaspidean* means that the plantar scutellæ are contiguous, rectangular, and arranged in regular series. If, as in the larks, the scutellation behind is formed by larger scutes in a single series, the term *holaspidean* has been used. In the taxaspidean tarsus it often occurs that all the scutellæ become fused in the old birds, which then have a booted tarsus, and such may be the origin of the nature of the tarsus of the Pittidæ, while the true ochreate tarsus, as it is found in the thrushes, is formed by simple fusion of the anterior scutes only.

In this connection it may be well to remember that only the Passeroideæ, or the acromyodian Passeres, are laminiplantar or holaspidean, and that most mesomyodian Passeres have ten primaries, the first of which is but slightly shorter than the rest.

The Tyrannoideæ are found in both hemispheres, though not one tenth of the nearly six hundred species composing the super-family inhabit parts of the Old World. They are chiefly tropical, and it is only in America that birds of this group extend their range considerably beyond the limits of the tropics, though the number of species with such a distribution is comparatively small. Of the Old World forms, one family inhabits parts of the Australian, Oriental, and Ethiopian regions, while another is restricted to Madagascar, and a third to New Zealand, a distribution of allied birds which, after what we have seen on preceding pages, cannot be strange to the readers of this volume.

A considerable diversity of form is shown by the members of this super-family. We have already mentioned the different tarsal structure to be found amongst them, but the bills and general habitus is also very variable. We will soon be introduced to forms which resemble the starlings, with their long and straight bills; others seem to have copied the thrushes, while again others have all the superficial look of a wren, and true flycatchers and shrikes are closely mimicked by tyrant-flycatchers and the 'American bush-shrikes'; even the 'conirostres,' finches, or tanagers, are not unrepresented in the clamatorial Mesomyodi. Indeed, so great is the external resemblance of these with some form or another of true Oscines that before their internal structure had become known they were classed with the isomorphic oscinine

group. This parallellism, however, is not more remarkable or inexplicable than the well-known isomorphism of some marsupials and placental mammals, and 'tenuirostral,' or 'conoirostral' Clamatores are not stranger than marsupial 'Carnivora' or 'Rodentia.'

It was not until 1882 that the XENICIDÆ were shown to be mesomyodic, and, consequently, were taken from the Oscines, having formerly been placed alternately in the families Certhiidae, Sittidae, Troglodytidae, and Sylviidae. In support of their present position amongst the clamatorial birds, I quote the following summary of their characters as given by the late Professor Forbes, the discoverer of their true relationship:—

"*Xenicus* and *Acanthisitta* are true mesomyodian forms, and therefore in no intimate degree related to such Oscines as *Sitta*, *Sitella*, or other 'Certhiidae,' since the syrinx has more of the complex nature of that organ in the Oscines, and there is no other intrinsic syringeal muscle than the thin lateral tracheal, the position of which is that characteristic of all the mesomyodian Passeres, resembling somewhat that of *Todus* (haplophone). Externally the non-oscine structure of their wings, which have a 'first' (tenth) primary nearly as long as the following (preceding) one, and of the tarsus, which is non-bilaminar, is at once apparent. Ten rectrices. No trace of plantar vinculum. Sternum has a single pair of posterior notches. Holorhinal. Vomer broad and deeply emarginated anteriorly, the maxillo-palatines slender and recurved. Perhaps nearest to Pittidae, though differing in many respects."

The present family is restricted to New Zealand, the genus *Acanthisitta*, consisting of one or possibly two species, showing some resemblance to the creepers, except for the extremely short tail, while the two species composing the genus *Xenicus* most remarkably personate our small short-tailed wrens, but their colors show considerable admixture of green. *X. longipes* is strictly arboreal in its habits, while *X. gilviventris*, according to Dr. Haast, is found in the high Southern Alps of New Zealand, exclusively amongst the large taluses of debris high on the mountain sides. Instead of flying away when frightened, or when stones are thrown at it, or even when shot at, it hides itself among the angular debris. *Acanthisitta chloris*, known as the 'rifleman,' especially in its habits resembles the creeper, for it is said to be generally seen running up the boles of the larger trees, often ascending spirally, prying into every chink or crevice, and moving about with such celerity that it is rather difficult for the collector to obtain a shot.

From New Zealand to Madagascar is not so long a step, ornithologically speaking. The PHILEPITTIDÆ form one of the most interesting forms of the latter island. They have been knocked considerably about in the system, and Mr. R. B. Sharpe even proposed to make them a sub-family under the birds-of-Paradise, while A. Milne-Edwards placed them next to the Nectariniidae, but Forbes showed, a few years ago, that they are mesomyodian with broncho-tracheal syrinx, though differing enough in detail to justify their position as a separate family. The most remarkable feature in regard to the intrinsic muscles is that at the lower insertion they are peculiarly expanded, though not fixed to the ends of the bronchial semi-rings, which are peculiarly modified. Of external characters we shall only call attention to the taxaspidean tarsi, the rather long wing-coverts, and the short tail, a peculiarity which the *Philepitta* have in common with all the Old World forms of the present super-family. The male has a large lobed and naked caruncle above the eyes, and both sexes possess a peculiar penicillated tongue. Only two species of the genus *Philepitta* are known — *P. castanea* and

P. schlegelii. Very little is known of the habits of these interesting birds. The last mentioned species is said to hop from branch to branch, mostly in pairs, looking for its food, which consists of small insects, especially coleopters.

It has been suggested by Mr. J. Gould that the curious *Melopitta* (or *Melampitta*) *lugubris* from New Guinea, with its velvety feathers of the face, might form the transition from the foregoing family to that of the *PITTIDÆ* which are often called the 'Old World ant-thrushes,' but its anatomy is yet unknown, and we, therefore, leave it with the latter, at least provisionally.

The pittas, on account of the form of their bills and the apparently booted tarsi, were by most authors held to be nearly related to the thrushes (*Turdidæ*) until quite recently, when Garrod demonstrated their mesomyodian or 'clamatorial' nature by



FIG. 231. — *Pitta coronata*, Bengal pitta.

actual dissection, thus verifying Dr. Cabanis' deduction from the length of the first (tenth) primary. The skull of the pittas exhibits one feature which is found in no other passerine bird, viz., that the temporal fossæ extend across the occipital region of the skull, and nearly meet in the middle line behind.

The species figured is the well-known Indian form *Pitta coronata*, which occurs from the Himalayas to Ceylon. It is olivaceous green; the head olivaceous ochre with a black line along the crown and one underneath each eye; throat white, but the rest of the under surface is light fawn-colored, abdomen and under tail-coverts strongly washed with beautiful rose-red; the upper tail-coverts and the smaller upper wing-coverts are shining sky-blue; on the wing a white speculum.

Alfred Wallace has given a most excellent account of their habits and distribution, from which we make copious abstracts in the following. To use his words, the pittas,

or ground-thrushes, are a group of insectivorous birds which inhabit the forests of the eastern tropics, and are generally adorned with brilliant and strongly contrasted colors. The rich blues and crimsons, the delicate greens, yellows, and purples, the velvety black and pure white (three of which tints at least generally adorn each species) remind one of the tanagers of South America; and, in fact, these two groups are almost the only ones which have no one characteristic tint or style of dress, but whose different species seem free to adorn themselves with the brightest hues from Nature's laboratory. There is, however, this difference, that, whereas the tanagers are a dominant group, abounding in genera, species, and individuals, over a very wide area, and presenting to our view much variety of form and almost every possible combination of colors, the pittas are a small and probably decreasing genus, with but slight modifications of form, and alike poor in species and in individuals. They inhabit a district which has been recently broken up into many fragments, and which seems to have been, during long epochs of the past, in an unstable and ever-changing condition. With the exception of the West African *P. angolensis*, which belongs to the same section of the genus as the species from India described above, all the pittas belong to the Oriental and Australian regions, being most abundant in the Malay Archipelago, about equally divided between the two regions. They attain, however, their maximum of beauty and variety in the large islands of Borneo and Sumatra, from whence they diminish in numbers in every direction, one species being found in North China, and only a few in Australia. It is interesting to remark that the species which are most alike form a section which spreads over the whole range of the family, the African and Chinese as well as one of the Australian species all belonging to the same group distinguished by its comparatively plainer colors, while the small islands of the Malay Archipelago show great contrasts in coloration, each island being usually inhabited by a distinct species. The following remarks of Dr. Wallace illustrate so forcibly several cardinal points in the question as to the influence of geographical distribution, or the origin of species, that we cannot refrain from quoting him in full.

"It is," he says, "interesting to remark that two species of the same group scarcely ever inhabit one island; where two or more species are found in an island, they almost invariably belong to as many distinct sections of the genus. This illustrates Mr. Darwin's theory of the extermination of closely allied forms by the more dominant race, and also of the effects of intercrossing in keeping up the uniformity of a species over a wide area. It thus happens that it is on the continent that the species have the widest range, though the varieties of physical condition in India, from the Himalayas to Ceylon, must certainly be greater than from island to island in the Archipelago. But those slight modifications which tend to bring a species into more exact harmony with surrounding conditions can be accumulated and rendered constant by 'natural selection' in an island where intercrossing with the forms of other districts is impossible; while on a continent the same mode of action will be very often neutralized by the intermingling of the various forms which must occasionally come in contact with each other, except where the habits of the animal are much opposed to locomotion. It is an interesting confirmation of this theory that the only species of *Pitta* which presents any well-marked varieties is that which has the widest range. Two or three forms of *P. bengalensis* [*P. coronata*, the species figured] have been described as distinct species; but it is found that these forms are unstable, and graduate into each other. We have here an evident tendency to produce distinct forms, which inter-

crossing continually prevents; but if continental India were broken up into three or four large islands (a change which the southern extremity of Asia has already undergone), we can hardly doubt but that a form specially adapted to the conditions, physical and organic, of each island would be developed by natural agencies from the variable material that we know already exists there. This segregation has already taken place to a remarkable extent in the archipelago. Generally speaking, each island, or little group of islands, has its peculiar species distinct from those of the islands that surround it. Some of these cases of localized species are among the most extraordinary known. The little island of Banda, hardly more than a mile across, has a species peculiar to it. Ternate, a mere volcanic satellite of Gilolo (Halmahera), and not more than ten miles from it, has a *Pitta* all to itself, though closely allied to the distinct species which inhabits the large islands of Gilolo and Batchian. The small, rugged metalliferous island of Banca, between Sumatra and Borneo (but so close to the former island as to seem only a detached fragment of it), has actually two species peculiar to itself; while, what is still more strange, the two allied species of which they seem to be modifications (*P. cyanoptera* and *P. muelleri*) are both common to the great islands of Sumatra and Borneo."

This latter case Dr. Wallace then explains by showing that Banca was already isolated at a time when Sumatra and Borneo were connected with the Malay peninsula, and that the nearness of Banca and Sumatra is quite recent, the nearest coast of the latter consisting of a soft alluvial soil, newly-formed by the action of tropical rains on the mountains way back in the interior.

The motions of the pittas he describes as very pleasing. They never seem to hurry, and yet get along at a great rate by hopping, generally on the ground, but occasionally perching on a stump or bush, and, when hard pushed, taking a long, straight, and silent flight. The voice of the smaller species he met with was a plaintive whistle of two notes, the second lengthened out and quickly succeeding the first, while the larger species seem to have three notes. The pittas seem not to answer to their vernacular name, 'Old World ant-thrushes,' as, according to Wallace, these insects are not their favorite food, which chiefly consists of coleopters, small orthopters, and worms, after which they dig with their powerful bills.

The remaining forms of the present super-family, without a single exception, inhabit the New World exclusively. Garrod discovered a peculiarity in the structure of some of them already mentioned, viz., that the pipras and cotingas have the femoral artery developed, in a word, are heteromerous, while the cock-of-the-rock and the tyrant-birds agree with all other birds in having the sciatic artery performing the duty as chief artery of the thigh, or are homœomerous. We are absolutely ignorant, however, of the taxonomic value of this character, and we are inclined to think that it is of no more account from a systematic point of view than is in most cases the diversities in the arrangement of the carotids. As, moreover, only few species have been investigated as to the vessels of the thigh, we shall disregard this character altogether in our present attempt.

The family TYRANNIDÆ, as a whole, may well be termed tyrant-birds, for a pugnacious temper and a tyrannical irritability towards other members of the feathered tribes, especially the rapacious birds, seems to pervade the whole group. Such a term is the more expedient, since in this polytypical family of more than three hundred and fifty species, it is difficult to invent suitable English appellations for the different kinds, and we may now style various birds tyrant-chats, tyrant-wrens, tyrant-flycatchers, etc.,

according to the more or less obvious resemblance they may have to the true (oscine) chats, wrens, or flycatchers.

The family is not difficult to define by means of external characters, as the tyrant-birds have exaspidean tarsi, and the outer and middle toes united only at their base, as in most Passeres. As an additional character may be added that the bill is more or less hooked at the tip, if we consider the genus *Oxyrhynchus* entitled to family rank on account of its curious straight and pointed, lengthened conical, and somewhat starling-like bill. The anatomy of the OXYRHYNCHIDÆ, however, is too little known to allow any certain conclusions, and if the form of the bill alone is taken into consideration such a separation seems hardly defensible in view of its great variability in the Tyrannidæ proper, in which, without dissent, are included birds with bills as different as that of a shrike, a warbler, and a flycatcher. The species of *Oxyrhynchus* are only two, one, *O. frater*, from Costa Rica and Veragua, the other from Brazil. The coloration resembles that of several other tyrant-birds, being green with a fiery orange crown patch.

The systematic arrangement of the tyrants is a matter of considerable doubt, as the numerous forms on one hand show extreme development of certain characters, while, on the other hand, they grade insensibly into each other, being connected all around by intermediate forms. We shall, therefore, not attempt here to define any sub-families, contenting ourselves by briefly mentioning the most noteworthy forms.

Notwithstanding the fact that the tyrants are chiefly tropical birds, — only one tenth of the whole number entering the fauna of North America, — the great bulk of the family is made up of very unsightly birds which are not particularly attractive, either by their coloration, by their form, or by their voice. The fundamental coloration, so to speak, seems to be gray, darker above, whitish beneath, but a common modification is that the whole plumage is washed with yellow, which causes the back to become olive and the under surface to be more or less pure yellow. A very common character is the shining yellow or red crown patch on top of the head, more or less hidden when the feathers are not raised. As this bright spot is invariably found in both sexes, the question has been raised whether it is an ornament acquired by sexual selection, or whether it may not have some other object. Mr. Charles W. Beckham has made the following suggestive observations on our common king-bird, or bee-martin (*Tyrannus tyrannus*):—

“Several years ago, in May, I saw one of these birds occupying an exposed perch on a pear-tree in bloom, about which many bees were darting. Several times I observed that the bird caught the insects without leaving his perch by quickly turning his head and ‘grabbing’ them. My attention being thoroughly aroused, I noticed that many of them seemed to fly directly towards him; the majority appearing to ‘shy off’ at a short distance and change their course, but very few that came within reach escaped him. The question naturally suggests itself: Did the thrifty Hymenoptera mistake the fully displayed orange red crown (I could see that the crest was erected) for a flower? Once since I have observed the same phenomenon, but not as well as upon this occasion. Mr. C. C. Nutting, who has spent considerable time studying the birds of Costa Rica and Nicaragua in their native haunts, states that he has seen *Muscivora mexicana* perched upon a twig, and waving its curious and brilliant fan-shaped crest after the manner of a flower swayed by a gentle breeze, and thus attracting insects within reach.”

Not all the Tyrannidæ, however, are plainly colored, nor is the family without such

capricious and extraordinary forms as the tropics usually produce, and a cursory glance at the more conspicuous species will soon convince us of the truth hereof.

Foremost in beauty among the tyrants is the graceful 'scissor-tail' (*Milvulus forficatus*) which inhabits Central America and some of our southern states west of the Mississippi. This bird is about as large as our common king-bird, but the tail — or more correctly the three, and more especially the two, lateral pairs of tail-feathers — is enormously lengthened, the length of the tail in a specimen before me being ten inches and a half, while the body without the tail is not more than four inches long. The coloration is quite unique, being above of a very delicate and light hoary gray, underneath nearly pure white, but on the flanks washed with a most exquisite salmon red, which on the lower tail-coverts and the outer rectrices fades into a lovely rosy tinge, while the feathers surrounding the insertion of the wing and those forming the concealed crown patch are fiery scarlet. A few remarks on the habits of this splendid member of our North American fauna may be welcome, hence we transcribe the following from Lieutenant McCauley's notes on the birds of the Red River, Texas: —

"This peculiarly beautiful and graceful bird was one of the species most frequently seen. They were especially active in the evening, just before dusk, skimming about in pursuit of insects with wonderful rapidity. As the males fly about the camp with their mates, in the twilight, you can single them out by the greater length of their tails. The two elegant feathery tines cross and open at volition, whence the ordinary simile to a pair of scissors. These birds are grace itself when on wing, darting here and there as quick as thought, in buoyant sweeps and curves. Even the teamsters call them 'mighty pretty,' and no one wonders that the 'Texicans' brag on their beauty, and call them 'birds-of-Paradise.' They were found frequenting the fringe of timber bordering the streams as far as their head-waters in the Staked Plain, as well as along the streams in the Indian Territory, all draining portions of the Arkansas Basin. They ruled the wood wherever located, and not only repelled, but hotly pursued, any sparrow-hawk that ventured near their homes, and even maintained authority over the king-bird."

Other forms with extremely lengthened outer tail-feathers are the large and handsome *Gubernates yetapa* from Brazil, gray with a dark chestnut band beneath the white throat, and *Alectrurus psalurus*, in which the external rectrices are denuded at the base, and the webs are turned vertically. The other member of this genus (*A. tricolor*) has the tail folded as in the domestic fowl, and the inner webs of the middle rectrices enormously broadened and raised above the rest.

The genus *Tunioptera* and its allies both in form and coloration strongly remind one of the Old World *Saxicola*, of which the white-ear is a familiar representative; while the kinglets are personated by the thin-billed, exceedingly beautiful, small *Cyanotis*, the head of which is ornamented with no less than six bright colors in the following order: chin white; ear-patch blackish indigo; superciliary stripe yellow and green; top of head black, relieved in the middle by a beautiful crown of the brightest scarlet orange, a color which also pervades the under tail-coverts. Here also belongs the interesting *Anæretes albocristatus*, a bird which in size and color closely resembles our black-and-white creeping warbler (*Mniotilta*), but which has a white crown, bordered on each side by a curious horn-like feather-tuft above each eye, somewhat after the fashion of certain owls.

The central group is occupied by a large number of species of small or medium

size with rather broad and depressed bills, among which are our common tyrant-fly-catchers, pewees, etc., belonging to a number of genera, the distinctive marks of which may be sought for in the special and formal text-books. We shall here only point out a single form, the vermilion fly-catcher (*Pyrocephalus rubineus*), the northern race of which (*mexicanus*) is found over our southern border, because of the unusual and strongly marked sexual difference, and of the exquisite coloration of the male, which is deep rosy vermilion, with a silvery white ear-patch, but chiefly on account of its musical voice, since it disproves the notion that the mesomyodian and oligomyodian birds must necessarily be harsh screamers. Mr. W. H. Hudson has given an interesting biography of the 'churinche,' as this species is called in South America, from which we select the following relating to its song: "A few days after their arrival the churinchés pair, and the male selects a spot for the nest — a fork in a tree from six to twelve feet from the ground, or sometimes a horizontal bough. This spot the male visits about once a minute, sits on it with his splendid crest elevated, tail spread out, and wings incessantly fluttering, while he pours out a continuous stream of silvery gurgling notes, so low they can scarcely be heard ten paces off, and somewhat resembling the sound of water running from a narrow-necked flask, but infinitely more rapid and musical. He is exceedingly pugnacious; so that when not fluttering on the site of his future nest, or snapping up some insect on the wing, he is eagerly pursuing other male churinchés, apparently bachelors, from tree to tree. At intervals he repeats his remarkable little song, composed of a succession of sweetly modulated metallic trills uttered on the wing. The bird usually mounts upward from thirty to forty yards, and, with wings very much raised and rapidly vibrating, rises and drops almost perpendicularly half a yard's space five or six times, appearing to keep time to his notes in these motions. This song he frequently utters in the night, but without leaving his perch; and it then has a most pleasing effect, as it is less hurried and the notes seem softer and more prolonged than when uttered by day."

Still more flattened and broadened are the bills of the small species of *Platyrhynchus*, which, besides, are remarkable for their extremely short tails, while the still smaller species of *Todirostrum* have similar but excessively lengthened bills.

Finally, as examples of the large and shrike-billed forms, the king-birds, may be quoted our bee-martin (*Tyrannus tyrannus*), the case of which, in regard to its alleged injuriousness in snapping the bees away as compared with its merits in defending the farmer's chickens against the hawks, will soon come up for decision by the ornithological juries of this country.

It would take us too far were we to go to relate the breeding habits of the different tyrant-birds, but we may briefly touch upon an interesting point, viz., how much the architecture of nearly allied birds may vary, as illustrated by the difference first pointed out by Mr. H. W. Henshaw in the nests of the two small species of *Empidonax*, of Eastern North America, *E. traillii* and *E. acadicus*, which are so alike in their external appearance that they have frequently been mistaken for each other even by experts. Mr. Henshaw describes the former as follows: "Hemp fibres compose the exterior or the bulk of the nest, while internally it is lined in true fly-catcher style with fine grasses and a slight admixture of down from thistles; the main point of all, however, is its position in an *upright* fork, the small twigs that surround it being made available to secure it more firmly in its place by being encircled with the stringy fibres." The nest of the Acadian fly-catcher, on the other hand, "is dis-

posed in a *horizontal* fork. It is a slight structure made of fine grasses, interspersed more or less with the blossoms of trees, the whole disposed in a circular form, and fitted between two twigs. The entire base of the nest is without support, and so thin is the slight structure that the eggs might almost be seen from below."

The pipras, or manakins, *PIPRIDÆ*, like the foregoing family, have exaspidæan tarsi, but the outer and middle toes are connected for a distance of two joints, hence the feet are syndactylous. Furthermore, they are heteromerous, as already mentioned. The pipras are mostly small birds, and nearly confined to South America, only a few species being found in Central America and Mexico. The sexes are very different in color, the females usually being dull greenish, while the males are mostly very gorgeously colored, generally of a deep glossy black relieved by the most brilliant scarlet, yellow, or sky-blue. Their figure is somewhat thick-set and the tail is generally short and square, but forms are found with very extraordinary tail ornaments, and, on the whole, the tail and wings seem to be the most variable parts, while the bill is of a very uniform shape throughout the family, being short, somewhat vaulted, and broad at base, the tip of the upper mandible being bent over the under one and notched behind the point.

The members of the genus *Heteropelma* are somewhat different from the general style of the pipras, being larger, and both sexes similarly dull colored. *H. vera-pacis* is peculiar to Mexico and Central America. Among the more conspicuous forms may be mentioned the *Pipra filicauda* from the Amazon, having the tail-feathers produced into long hair-like, but stiff, threads; the exquisitely colored *P. suavissima* from Demerara, of a deep velvety black, against which is set off in the strongest contrast imaginable the glossy sky-blue of the rump, the bright orange of the abdomen, and the white forehead slightly tinged with beryl blue. The manakins proper, the typical species of which, *Manacus manacus*, is figured on the plate opposite this page, are to be mentioned on account of the beard-like elongation of their chin-feathers, and the attenuation and falcation of the primaries. The species figured is black, gray, and white, exactly as shown in the drawing, the gray being a little more bluish; and hails from northern South America, while *M. candei* from Central America and Mexico has the posterior half of the body beautifully tinged with yellow. In the members of the genus *Chiroxiphia* we meet a different style of coloration, the back usually being light blue, while the head is adorned with a crimson crown patch, the central tail-feathers are often more or less lengthened, and the frontal and nasal feathers show a tendency towards the velvety antrorse tufts, which reach their highest development in *Masius coronulatus* and in *Antilophia galeata*, both velvety black, the former with top of the head and the tuft yellow, the latter with the same parts, including the upper neck and anterior back gloriously crimson scarlet. Most curious in form and color, however, is the genus *Macharopterus*. The typical species are green with fiery red crown, and the lower surface most curiously striped brown and whitish lengthwise. The inner secondaries have the shafts thickened and hardened, ending in a pointed claw, a structure carried out to an excessive degree in the more uniformly chestnut-colored *M. deliciosa*. Dr. Ph. L. Selater, who originally described this species, gives the following account of this odd structure of wing: "The ten primaries are of the ordinary formation of birds of this family. The first three secondaries are thick-stemmed, and curved towards the body at a distance of about two thirds of their length from the base. The fourth and fifth show this structure to a greater degree, with same corresponding alteration in the barb on each side, as may be seen from Fig.

232, *a* representing the upper surface of the fifth secondary of the male bird. In the sixth and seventh secondaries of the male, the terminal half of the *rachis* is thickened to an extraordinary degree, forming a solid horny lump. The external and internal barbs are also much modified in shape, and generally curtailed in size. Mr. Fraser states that the wing-bones of these birds were also much thickened, no doubt in aid of this abnormal structure of the wing."

The pipras are said to resemble our tits and chickadees in their habits, hopping about in the lower bushes and partly nesting on the ground. *Chiroxiphia caudata* is known in Brazil as the 'dansador,' on account of a peculiar play or dance which often is performed when a few of them are together. One of them keeps up whistling with all his might while the others are jumping and dancing on the twigs round about him; when he gets tired he is relieved by another bird, and he himself joins the dancing chorus.

The so-called cock-of-the-rock (*Rupicola*) takes a position somewhat intermediate between the Pipridæ and the Cotingidæ, inasmuch as it is syndactylous, like the former, but pycnaspidæan, like the latter family. It has, consequently, by ornithologists, been referred to one of them as well as to the other. Taking into consideration that it is homœomerous, like most other birds, the supposition seems not unreasonable that it is more nearly related to the ancestral stock than the pipras and the cotingas proper, and that all three should be united in the same family.

This singular bird, which is well figured on the plate facing page 472, is of a beautiful orange-yellow color, with a curiously compressed and rounded crest on the head, somewhat resembling that of the quezal, and nearly concealing the upper mandible. The female is much plainer, being of a dull olive brownish. Another species is *R. peruviana*, very similarly colored, but the crest without the subapical brownish band. The intensity of the red in the orange color seems to vary according to the geographical distribution, two additional races being perhaps recognizable, *R. peruviana saturata* and *R. peruviana sanguinolenta*. The females are of a dull olivaceous brown. The cocks-of-the-rock are restricted to the interior parts of northern South America. Being of the size of a magpie, they of course are very showy, and have always attracted great attention, not the least because of the peculiar plays and dances which the males perform in the breeding season. They meet at certain places, and the females are interested spectators, the whole performance strongly reminding of similar games among the gallinaceous birds. A visit to the breeding place of *R. sanguinolenta* is described by Mr. T. K. Salmon as follows: "I once went to see the breeding place of the cock-of-the-rock; and a darker or wilder place I have never been in. Following up a mountain stream in the district of Frontino (State of Antioquia), the gorge became gradually more enclosed, and more rocky, till I arrived at the mouth of a cave, with high rock on each side, and overshadowed by high trees, into which the sun never penetrated. All was wet and dark, and the only sound heard the rushing of the water over the rocks. We had hardly become accustomed to the gloom when a nest was found, a dark bird stealing away from what appeared to be a



FIG. 232. — *a*, fifth and *b*, sixth secondaries of the male *Machalopteron ruficauda* from above; *c*, seventh secondary from below.

lump of mud upon the face of the rock. This, upon examination, proved to be a nest of the 'cock-of-the-rock,' containing two eggs; it was built upon a projecting piece, the body being made of mud or clay, then a few sticks, and on the top lined with green moss. It was about five feet from the water. I did not see the male bird; nor, indeed, have I hardly ever seen male and female birds together, though I have seen both sexes in separate flocks." The eggs are described as pale buff, spotted with various sized spots, of shades from red-brown to pale lilac, chiefly at the large end.

The greater number of the species of the Cotingidæ are plain-colored, gray, rufous, or greenish, as, for instance, most species belonging to the genera *Tityra*, *Pachyrhampus*, *Lipaugus*, etc., though even among these rather modest forms there are some which are more or less highly adorned. Amongst these is the rose-breasted 'fly-catcher,' *Hadrostomus aglaie*, gray, with a beautiful crimson rosy patch on the breast, which just enters our fauna across the southern frontier. Nevertheless, the cotingas are generally considered especially bright-colored and curiously adorned birds, on account of the unrivalled splendor and marvellous ornaments of a number of tropical forms, chiefly from the northern parts of South America. From Central America we have the exquisite *Carpodectes*, white all over, with a delicate tinge of bluish gray washed over the upper surface; from Guiana to Brazil are found the deep purplish-carmine *Nipholena*, with white remiges, and the great wing-coverts singularly lengthened, narrowed, and stiffened like a woodpecker's tail-feathers; the glorious *Cotinga*, shining azure blue, with purple throat, from the same countries; the greenish, fork-tailed *Phibalura* from Brazil, and the small, pipra-like *Iodopleura*, curious on account of the rare lilac color of the sides of the body hidden under the wings. All these are well known and conspicuous members of the group, the females of which are plainly colored, mostly gray. But while these forms excite our admiration, a number of others exhibit features and ornaments so odd as to completely amaze the observer when first introduced to them. Most of these are rather large birds, the *Pyroderus* reaching the size nearly of a crow. It would take too much space were we to mention all of them, hence we only offer some few remarks on the species figured on our plate.

The first to come in for our consideration is, then, the curious umbrella-bird (*Cephalopterus ornatus*), black all over, varied with metallic blue reflections, and of the size of a crow; as Mr. Wallace says, were it not for its crest and neck plume, it would appear to an ordinary observer nothing more than a short-legged crow. The same gentleman, who met the species on the Amazon, thus describes the ornaments from the fresh bird as follows: "The crest is perhaps the most fully developed and beautiful of any bird known. It is composed of long, slender feathers, rising from a contractile skin on the top of the head. The shafts are white, and the plume glossy blue, hair-like, and curved outward at the tip. When the crest is laid back, the shafts form a compact white mass, sloping up from the top of the head, and surmounted by the dense, hairy plumes. Even in this position it is not an inelegant crest, but it is when it is fully opened that its peculiar character is developed. The shafts then radiate on all sides, from the tip of the head, reaching in front beyond and below the top of the beak, which is completely hid from view. The other singular appendage of this bird is the neck plume. On examining the structure of this plume, it is found not to be composed of feathers only, growing from the neck. The skin of the neck is very loose; looser and larger, in fact, than in any bird I know of. From the lower part grows a cylindrical fleshy process about as thick as a goose-quill, and an inch and

a half long. From this grow the feathers to the very point, thus producing the beautiful cylindrical plume quite detached from the breast, and forming an ornament as unique and elegant as the crest itself."

The other bird figured is the male of the naked-throated bell-bird (*Usmarkhincos nudicollis*), white, with the naked parts green, inhabiting the dense forests of Brazil. With its congeners it is especially celebrated for its extraordinary voice, which is compared with the tolling of a bell, or the sound produced by the blows of a hammer on an anvil. Two of the species have most remarkable caruncles on the base of the bill, the 'Campanero' (*C. niveus*) from Cayenne, having one fleshy, erectile, and cylindrical appendage nearly three inches long, black of color, and ornamented with small, white, star-like feathers, while *C. tricarunculatus*, from Costa Rica, has three enormous band-like caruncles on the forehead where it joins the bill, and one on each side at the corner of the mouth.

The cotingas are very much like enlarged pipras, and have also some resemblance to our cedar-birds (*Ampelis*), hence they were formerly classed with the latter. Their structure, outside of the peculiar ornaments already referred to, is rather uniform. Their diet is a mixed one, consisting chiefly of fruits and insects.

We have finally to mention the last family of the present super-family, the plant-cutters, PHYTOTOMIDÆ, with a single genus (*Phytotoma*) consisting of a few species ranging from Bolivia to the Argentine Republic and Chili. In their external appearance they closely resemble some conirostral oscines, with which they have been often associated in the systemot. The coloration is brownish, streaked with black, but their internal structure is very interesting since they represent the finches among the mesomyodian Passeres; hence we are obliged to go a little into detail.

The skull of the plant-cutter is described by Parker as on the whole "a most remarkable and evidently ancient form, although unique in many of its characters." According to his nomenclature, its palatal structure (Fig. 233) is compound ægiognathous of the feeblor type occurring in some mesomyodian forms, for instance *Pitta*, *Pipra*, *Thamnophilus*, and which is characterized as a kind of passerine desmognathism produced by the maxillaries coalescing with the ossified alinasal wall, but not with the nasal septum as is the case with the oscinine palates of the compound type. In many other points the palate of *Phytotoma*, especially in its anterior part, shows considerable resemblance to some of the oscinine conirostres; in the former there is a row of clearly defined denticles, both along the dentary and palatine ridges of the premaxillary. Professor Parker imagines that these knobs are "remains of what are apparently but recently lost teeth—that is, speaking palæontologically,"—an interpretation which to us seems doubtful, to say the least. Altogether the palate, in spite of its adaptation to a bill isomorphous with that of the tanagers and finches, shows near relationship to that of the other members of the present super-family, besides that mentioned above, for instance, in the spur-like process from the maxillo-palatines postero-externally; but entirely unique, in the present order, are the plover-like nasal-gland grooves at the orbital cæve. We fully agree with Professor Parker that the plant-cutter "is marked off from its nearest known congeners—a species representing a genus, and even a family, quite unique."



FIG. 233. — Palate of *Phytotoma*, conirostral, ægiognathous. *max*, maxillo-palatines; *pt*, palatines; *pt*, pterygoids; *v*, vomer.

The plant-cutters are charged with being extremely injurious to the farmers, since with their serrated bills they cut the young and tender sprouts and buds, doing great damage to the plantations where they occur in any numbers. Their habits are said to resemble those of the tanagers of the genus *Saltator*. Being a 'clamatorial' bird, the *Phytotoma* has a cry which "could not be much more disagreeable, as it resembles the noise made by the grating of the teeth of one saw against those of another."

We have already designated the tracheophonous mesomyodic Passeres as FORMICAROIDEÆ, or ant-birds, and it remains now only to treat briefly of the different families belonging to the super-family defined in the above words. At the outset, however, we may remark that the present group, which embraces about five hundred species, is absolutely confined to the Neotropical Region, not a single species being known to occur, even accidentally, within the limits of North America, nor have any ever been found in any part of the Old World. It is also noteworthy that this super-family is entirely absent from the West Indies.

In having depressed beaks and exaspidean tarsi, the CONOPOPHAGIDÆ agree with the tyrant-birds, with which they are most commonly classed. Their position in the present super-family, however, is clearly dictated by the tracheal position of the syrinx, which, by the way, has no intrinsic muscles. That their correct place is here, is furthermore demonstrated by several other features, in which they agree especially with members of the following family, the Pteroptochidæ, viz., the four-notched sternum and the quasi-picarian insertion of the tensor patagii brevis tendon, the returning portion of which is concealed by the muscular fibres at the origin of the extensor metacarpi muscle, as discovered by Forbes.

This family comprises two genera, if *Corythopsis* really belongs here, and a little more than a dozen species, confined to tropical South America. They are small birds, of sparrow-size and smaller, *Conopophaga*, with extremely short tail, and the typical species with a white, silky feather-pencil behind the eyes. The ant-pipits, as *Corythopsis* may be termed, have normal tails and a general resemblance in form and coloration to the oscinine pipits. Sundevall places this genus with the Formicariidæ. Very little, if anything, is known in regard to the habits of these birds.

Like the foregoing family, the PTEROPTOCHIDÆ have a four-notched sternum, and a masked passerine insertion of the tensor patagii brevis, but their tarsi are taxaspidean. In their palate, however, they exhibit quite an oscinine feature, their maxillopalatines being slender processes curved backwards. In their external appearance some of them, at least, resemble the wrens very much, — so much, indeed, that one of the earliest known species of the family was originally described as *Troglodytes paradoxus*, and some of the young *Scytalopus* are amazingly like our winter-wren. In this respect, as also in the four-notched sternum, they agree with the Australian genus *Atrichornis*, and might have fitly been termed ant-wrens, had the latter name not already been given to another group of the Tracheophonæ. From the true wrens they are easily distinguished externally by the long first (tenth) primary, the taxaspidean tarsus, and the peculiar operculum overhanging the nostrils. The family consists of less than two dozen species, most of which are restricted to the zoological province embracing Chili and western Patagonia, two generic types being entirely peculiar to this region.

In accordance with their skulking habits, the general coloration of the Pteroptochidæ is dusky brownish, or blackish, and none are especially remarkable, either on account of color or any striking external peculiarity, except, perhaps, *Acropternis*

orthonyx, from Ecuador and the United States of Colombia, which "is readily known by the extraordinary flat, oval shield into which the culmen is developed, and the long, straight hind claw. Its ocellated plumage is likewise unique among the Passeres," and reminds one forcibly of some small Gallinaceous birds.

Darwin gives interesting accounts of several of the species. Of *Hylactes tarnii* he says that it is called by the native Indians *guid-guid*, but by the English sailors the barking-bird, a name very well applied, since the noise it utters is precisely like the yelping of a small dog. It feeds exclusively on the ground, in the thickest and most entangled parts of the forest, and rarely takes wing, but hops quickly and with great vigor, carrying the short tail in a nearly erect position. *H. megapodius* is called by the Chilenians 'El Turco.' "Its appearance is very strange, and almost ludicrous, and the bird seems always anxious to hide itself. It does not run, but hops, and can hardly be compelled to take flight. The various cries which it utters, when concealed in the bushes, are as strange as its appearance."

Apparently closely allied to the foregoing family, though with only two sternal notches and normal passerine insertion of the tensor patagii brevis, is the taxaspidean family FORMICARIIDÆ, a large and characteristic South American group of considerably over two hundred species, which seems to be eminently natural. Mr. D'Orbigny remarks as follows: "All the species of this family, independently of their being of the same habits, have a *facies* which unites them together. Their most salient traits are the long, slender tarsi and toes, the exterior toe united to the middle at its base, the moderate claws, the fine elongated feathering of the rump, and, in particular, the spots of white which occupy the base of the interseapularies in the wings of nearly all the males."

The present family is divisible in three groups, which have been termed sub-families, viz., the ant-shrikes (*Thamnophilinæ*), strongly-built birds, with a strong, deep and compressed bill, hooked and toothed at the end, and a long, broad-feathered, much-rounded tail, presenting a great resemblance to the genuine, oscinine shrikes. The sexes are very differently colored, the males being varied with black and white, the females with brown. The ant-wrens (*Formicivorinæ*) are smaller and weaker, with slenderer, scarcely hooked bill. The tail varies much, being in some genera very long, and in others extremely short. Sexes as in the foregoing group, with but few exceptions. The members of the third group are called ant-thrushes (*Formicariinæ*), and, except in regard to coloration, are very much like the pittas, having long tarsi, large feet, a thrush-like bill, and an extremely short, square tail; and, like their Old World relatives, their habits are entirely terrestrial. The sexes are usually colored alike. These sub-families are not very trenchantly defined, intermediate forms occurring all around; and Mr. Selater, from whose synopsis of the present family the above is mostly borrowed, freely admits that it is difficult to draw a precise line, and say where one sub-family ought to end and the other to begin.

It is entirely out of question to go into detail concerning the different genera or species, or their habits individually, for they are not particularly attractive to the general reader, and the habits, as far as they are known, seem to be rather uniform. On the whole, they are birds of very retired manners of life, spending their time amongst the densest and thorniest thickets. Curiously enough, nearly all of these non-oscinine birds are said to possess voices of special ventriloquial power, though Mr. Salmon, as will be seen from the following quotation of his account of the habits of *Grallaria rapicapilla*, explains the omnipresence of the voice as the result of the bird's

own ubiquity. He says: "In the morning, and shortly before sunset, may be heard a melancholy cry, as this ant-thrush creeps amongst the brushwood. Many times have I followed, to obtain a specimen, and, after a tough scramble of an hour, given it up for a bad job. At one time you seem to stand right upon it, and a moment after you hear it four yards off; again you reach the spot, and you hear it twenty yards behind you; you return, then it is to the right; soon after, you hear it on the left. At first you imagine the bird has the power of a ventriloquist; but, by dint of patience and watching, you may see it creeping swiftly and silently among the grass and brushwood in places where it has to pass a rather more open spot, and the mystery is explained. The nest is also difficult to obtain; it is placed at some height from the ground, and made of a mass of roots, dead leaves, and moss, lined with roots and fibres. The eggs are two in number, rather round and blue."

In now turning to the last two families of the present super-family, which are distinguished from the rest by having endaspidean tarsi, we have to remind the reader of an osteological character, of which we heard considerable during the earlier part of this volume. It will be remembered that several 'swimmers' and 'waders' distinguished themselves from others of these antiquated 'orders,' and from most other birds, by being schizorhinal, that is, by having the posterior angle of the external nares passing *behind*, instead of in front of, the ends of the nasal processes of the præmaxillæ, all other birds being holorhinal. Picarians and Passeres were, therefore, all considered holorhinal until Garrod, in 1877, demonstrated that certain tracheophone Passeres, regarded as belonging to the family Dendrocolaptidæ, are schizorhinal, like the plovers and gulls. Curiously enough, this specialization, which is quite unique in the order, is combined with slender maxillo-palatines, curved backwards, as in the Oscines, a feature only found elsewhere in the Pteroptochidæ among mesomyodian Passeres. The significance of these structures is not quite clear yet, but it is safe to assume that the schizorhinal Formicarioideæ form a very natural group, since it is very improbable that such a unique development should have started independently in two or more forms. We therefore accept it as indicating family relations, following Garrod's proposition in dividing the endaspidean Formicarioideæ in the holorhinal Dendrocolaptidæ and the schizorhinal Furnariidæ.

The DENDROCOLAPTIDÆ, or woodhewers, represent the woodpeckers in the mesomyodian series, chiefly on account of the pointed and stiffened tail-feathers, the ends of which are denuded, and in some forms quite claw-like. The object of this peculiar structure of the rectrices is the same as in the woodpeckers, that is, to support the bird when climbing on the trunks of trees, as by being pressed against the bark it prevents the bird from slipping backwards. The foot is not zygodactylous, however, though it is nearly as peculiar and specialized for the purpose of climbing. The outer toe is about as long as the middle one, and this is considerably longer than the innermost toe, thus giving the foot a very singular appearance, the more so since all three toes are closely bound together at the base for the whole length of the first phalanx. The bill, on the other hand, presents no resemblance to the wedge-shaped chisel of the woodpeckers, it being more or less curved, generally quite slender, and often extraordinarily lengthened, as, for instance, in the genus *Nasica*. It is therefore easy to understand that the Dendrocolaptidæ do not use their bills as hammers or axes in digging holes in the solid wood of trees, like the woodpeckers. Some species, as, for instance, the typical *Dendrocolaptes*, which are marked with dense dusky cross-bars, recall, in their coloration, certain brown Indian woodpeckers,

but the characteristic red ornaments of the latter are entirely absent. A peculiar style of coloration pervades the whole family, however, all the species being of some shade of brown, usually with the secondaries, rump, and tail rufous, while the breast, and often the head and the back, are adorned with whitish drop-spots or shaft-streaks. Indeed, so uniform is the aspect of all the members of the family, that we see no reason for specially mentioning any particular species, inasmuch as the habits, which, however, are very little known, seem to be equally uniform. Their movements on the trees are said to be just like those of the woodpeckers. The species of woodhewers are not very numerous, hardly more than some eighty being known, ranging from Chili and La Plata to Mexico.

Representatives of the different types of the FURNARIIDÆ have been examined as to the structure of the nares, and have been found to be schizorhinal. We are, therefore, justified in presuming that this condition is a character shared by the other species, and peculiar to the family. Externally, they differ from the Dendrocolaptidæ in having the middle toe longer than the two lateral toes. Otherwise the two families have many features in common. Thus many of the Furnariidæ have pointed and somewhat stiffened tail-feathers, representing as they do the creepers and nuthatches amongst the Clamatores. Even in coloration there is a great resemblance to that of the foregoing family. On the whole, the coloration of the Formicaroideæ deserves a few remarks. All these birds with a mesomyodian tracheal syrinx are exclusively neotropical. They consequently hail from a part of the world which justly is regarded as the home of some of the gaudiest-colored birds which our globe has produced,—humming-birds, tanagers, parrots, toucans, jacamars, trogons, etc. How often has it not been thoughtlessly repeated that, while the tropical forests foster brilliancy of plumage, the temperate climates are the home of the plain and dull-colored species, and that kind nature has given the modestly dressed birds the power of sweet song as a compensation for the lack of beauty. But here is a neotropical super-family of ‘songless’ birds, nearly five hundred species of a number of different genera and families, not one of which is adorned with a single bright-colored feather! All the variation of color is from white to black, through brown and rusty; and so uniform is their style that not even green, otherwise so common a color among birds, is found on any form which really belongs in this super-family, a proof more of the great naturalness of the group.

The remarkable impersonation by mesomyodian birds of well known oscine types is also very strongly marked in the present family, for in *Geositta* and its allies we have a complete repetition of the larks, not only in colors, but also partly in habits, since they are entirely terrestrial birds, while some species of *Synallaxis* are most astonishing counterparts of the tree creepers (*Certhia*) in movements, size, form, and color. Peculiar in regard to the form of the bill are the genera *Xenops* and *Pygarrichus*, in which the lower mandible is bent upwards and slightly falcate, distantly reminding of the corresponding structure in the parrot-auk (*Cyclorrhynchus*) and in some kingfishers.

A closer characterization of the different species, genera, or even sub-families, of the Furnariidæ would only be an uninteresting series of notes respecting comparative dimensions, more or less stiffness and pointedness of tail-feathers, greater or less amount of gray, or rufous, in the plumage, and may, therefore, be entirely dispensed with. But as the chief interest of this family lies in the remarkable nesting habits, we propose to give a fuller account of this side of their economy.

In speaking of the species of the creeper-like, point-tailed *Synallaxinæ*, of Lower Uruguay, Mr. W. B. Barrows observes as follows: "These birds are very abundant at Concepcion, their nests being one of the most noticeable features of the landscape. There are places within two miles of the centre of the town where I have stood and counted, from one point within a radius of twenty rods, over two hundred of these curious nests, varying in size from that of a small pumpkin to more than the volume of a barrel. Often a single tree will contain half a dozen nests or more, and not unfrequently the nests of several different species are seen crowding each other out of shape on the same bush or tree. Most of the smaller species are so similar in color and motion that they cannot possibly be distinguished from each other at a distance of twenty feet. And it can easily be imagined how difficult it is to collect eggs and be sure of their identification. The eggs of most species are as much alike as the parrots themselves; often more so, for the eggs are always either white or pale blue."

One of the most interesting structures is that of the thorn-bird (*Anumbius annumbi*), described by the same author as follows: "The bird is not larger than our wood-thrush (*Turdus mustelinus*), but its nest is sometimes four feet in length, with an average diameter of two feet. Probably no nest as first completed would show these dimensions; but as the same nest is used for several seasons in succession, its size increases, until it may even exceed the above measurements. The bird builds its nest of twigs and thorns, placing it either on a tree or bush, sometimes low enough to be reached by the hand, sometimes at a height of twenty or thirty feet. The first new nest I ever examined was built in an ombú tree at Buenos Aires, and measured about two and one half feet in height by fifteen inches in diameter. The larger diameter was vertical, and the opening at the top gave access to a passage-way, barely large enough to admit the hand, and twisting regularly in a spiral to near the bottom, where it enlarged somewhat to form the nest cavity. The spiral passage-way made rather more than two complete turns between orifice and nest, and in so doing passed between two branches of the tree so close together as barely to allow the passage of the bird. I have several times seen nests in which these passage-ways were made to pass completely around the (small) main stems of the trees on which they were built. In other nests, the passage-way, though never straight, was by no means a spiral."

The nest of the oven-birds (*Furnarius*) is quite a different affair, being, as the name of the bird indicates, an oven-shaped structure built of clay. Once more we resort to Mr. Barrows' excellent account of the nesting habits of these birds, from which we quote the following, relating to the nesting of the 'hornero,' as the red oven-bird (*Furnarius rufus*) is called, in lower Uruguay: "The nest is built of such mud as can be found near at hand, and if the mud contain grass-roots or similar fibres, so much the better, but I do not think the birds worry themselves much about the quality of the materials. Although the eggs may not be laid until September or October, the birds often begin work on the nest as early as the middle of June, thus occupying three months or more in its completion. In fact I doubt if there is any month in the year when one cannot find oven-birds at work on their nests. If the weather is dry they suspend work for a week or two until a shower refills the muddy pool from which they draw their building material, when they go on leisurely as before. This is the case only in winter, and when there is nothing to cause haste. In spring and summer the case is entirely otherwise; a nest may then be begun and finished within a week. But a winter-built house is usually much the best, and not a few such withstand the rain and heat for a year or more, if not sooner pulled down by boys, iguanas,

or birds of prey. The clayey mud bakes almost to brick, and it is no easy matter even to break out a hole large enough to extract the eggs. The nests are rather less than a foot in greatest diameter, and though the eggs are not visible from the entrance the common statement that there is an 'ante-chamber' to the nest seems to me not quite accurate. The nest is built very much like a spiral shell, and if one could remove the inner whorls from such a shell as *Ampullaria* he would have quite a fair miniature of the hornero's nest. The eggs are seldom more than three in number, and are originally pure white, but being laid directly on the muddy floor of the nest they soon acquire about the same color. I have taken them from September 16 until January 15, but the larger number are, I think, laid during October."

Finally, we shall have to copy Mr. Gibson's observations on the curious burrowing habits of the terrestrial and lark-like *Geositta cunicularia*, made in Buenos Aires: "This is a most common bird in the camps or plains, to which it is confined, though we may notice it about the borders of any wood also, should there be a biscachero (colony of *Lagostomus trichodactylus*) situated near. On the 16th of August I have seen the excavation of a nest begun. This (with us, at least) is invariably situated in the brow of one of the burrows of a biscachero; and as a new one is made every year, it is often difficult to tell which hole to open up. The passage varies in length from two to four feet, with a slight downward tendency, and terminates in a cavity shaped like a cocoa-nut, but a little larger. This is prepared for the reception of the eggs by a pile or cushion of soft dry grass, sometimes very sparse. The slope of the passage I have always found to be correctly calculated, so as not to disconcert the bird by a possible emergence into the open air, should the ground fall away behind the burrow. The bird sits close, and may often be excavated with the nest. Three is the general number of eggs laid. The color is white."

As the Passeres form the largest order among existing birds, so are the PASSEROIDEÆ the largest super-family, agreeing exactly with the *Acromyodi normales* of Garrod, the *Oscines* of Keyserling and Blasius, Müller, Cabanis, and others, and the *Laminiplanteres* of Sundevall, plus the larks. So far the harmony amongst systematists is great and unusual. But when we come to subdivide this enormous group, the unanimity suddenly comes to an end, and, to use Professor Parker's words, "A hundred classifiers, a hundred so-called systems!"

Having the task now before us of selecting one of these hundred systems, or, if they do not suit us, to propose number one hundred and one, at least for our own use, we will have to follow the principle which has guided us so far, viz., to begin with the most generalized forms, proceeding towards the most specialized ones, whenever the present status of the science enables us to draw reliable conclusions in that respect. Our view in regard to the present super-family is fairly expressed by the following quotation from Professor Newton: "Hard though it be to find definitions for the several groups of *Oscines*, whether we make them more or fewer, it is by no means so hard, if we go the right way to work, to determine which of them is the highest [most specialized], and, possibly, which of them is the lowest [most generalized]." But it must at the same time be borne in mind that a linear arrangement is as impossible in this as in any other polymorphous group; an attempt to arrange all the forms belonging here, in one natural series, is bound to fail, because it is against Nature.

In most modern systems we find that the 'highest' position has been granted the *Turdidæ*, partly because some of that family are among the best songsters, partly because they possess the most specialized tarsus, the scales, both in front and behind,

being fused into continuous lamina, or 'boots.' Professor Newton has made a very successful assault upon this arrangement, the most forcible argument being the rather generalized state of their coloration, the young ones being very different from the adults, and spotted. But he is probably going too far when he thinks that "so far from the Turdidæ being at the head of the Oscines, they are among its lower members." This view is entirely opposed to that of Professor Parker, whom Newton quotes in defence of his assigning the first position to the crows. But if Parker's opinion has any weight as to one family, it probably is of some importance in regard to another; and as to the "warblers," as typified by the European redstart, which most certainly belongs to the Turdidæ, the latter gentleman says that "in the fulness of their organization as to all that lifts a bird on high above a reptile, or above a reptilian bird, these types are, as to *family*, what a blood-horse is as to breed; they are of the highest and the purest blood. That these birds (the very aristocracy of the 'Oscines,' or songsters) are small does not much affect the question; for if we wish to look for a *low* bird of mean reptilian blood, we search for it amongst the ponderous giants."

In order to find out the most specialized form of the Passeres, we must look for the bird which is most specialized in all directions, not only as to the coloration of its plumage, or the fusion of its tarsal covering. The *ideally highest* form of this superfamily would have booted tarsi, nine primaries, long mandibular symphysis, powerful bill for grain-crushing, a digestive system adapted to grain-feeding, and coloration of young and adults unspotted and similar. That this is the regular course and ultimate end of the evolution among the higher birds is evident from the fact that we can trace it in nearly all the groups, and in the individual development of the birds possessing these characters. Thus the young of birds with booted tarsus have the tarsal covering yet divided into scutellæ; in nine primaried birds the tenth primary can be seen in the unfledged young, and in those with the tenth (usually called the first) primary aborted, it is longer in the young bird than in the adult; grain-feeding species are insectivorous and feeble-billed when young, and in young birds the symphysis of the mandibular rami is shorter than in the adults; and, finally, a uniformly colored plumage usually develops from a spotted one, and, as far as we know, never a spotted plumage out of a uniform one.

A passeroid bird combining all these characters is not known, but the above combination is that standard by which the different claimants have to be compared. The form which comes nearest to the standard will have to take the 'highest' place.

It is then apparent that the Turdidæ, whether including both thrushes and Old World warblers, or only the former, do not fill the bill, in spite of the booted tarsi. The little kinglets (*Regulus*) which combine this character with an unspotted young plumage make a good showing, and should stand highest in their family; but their beak and palate are not particularly specialized, and the wing has ten primaries.

The Corvidæ, or crows, have recently come to the front, advocated by Professor Newton, who thinks that "he would be a bold man who would venture to gainsay" Parker's opinion, that "in all respects, physiological, morphological, and ornithological, the crow may be placed at the head, not only of its own great series (birds of the *crow form*), but also as the unchallenged chief of the whole of the 'Carinatae.'" Not only has Parker himself partly neutralized, not to say gainsaid, this passage by the one quoted above, but I think that the risk in challenging the crow's claims cannot be so very great. This type of the genus *Corvus* does certainly not stand the

morphological test above alluded to. The character of the corvine tarsus is very 'low' indeed, and it may even be questioned if it can be called laminiplantar. I submit Fig. 234, drawn by myself from a fresh specimen of an old raven (*Corvus behringianus*), from which it will be seen that the plantar covering consists of one lamina on each side, separated from the other by one row, and from the anterior scuta by one or more rows of scutellæ. The crows, furthermore, have ten primaries, the first (tenth) one being among the longest in oscinine birds. The bill, in spite of its strength and size, is not particularly specialized, and the symphysis of the lower mandible is remarkably short throughout nearly all the family. There remains the color-character of the plumage, which, if considered alone, would procure a high rank for the crows; but several other groups might claim the same with equal propriety. But then it is urged that the crows, in regard to the relative size and weight of the brain as compared with the body, take a high and exceptional position, and that the "likeness between young and old is, so far as is known, common to every member of the family," while it does "not extend to more than a portion, and generally a small portion," of the other groups in which a similar likeness occurs. I will assert, however, that this is not exactly the case, and that the Paridæ, or tits, will be equally entitled to the highest rank on the same grounds. For in all Paridæ undoubtedly belonging to the family, the color of the adults and young is essentially alike, and, as a whole, the magnitude of their brain is not less. Moreover, the uniformity of the corvine plumage is not so exceptionless as Professor Newton thinks, for the young of the Canada jays (*Perisoreus*) differ considerably from the adults, and the young nut-crackers (*Nucifraga*) are much more speckled than the adults.

In my search for the most specialized Passeres, I have fallen back on Sundevall's original idea of placing the Coniostres, or finch-forms, at the end (or the head, as others would say) of the series. True, their tarsi are not booted, but in all the other points the most specialized genera come up to the standard above alluded to. This will be easier demonstrated by taking one example, for which we select one of the species to be placed at the end, namely, our evening grosbeak (*Hesperiphona vespertina*). The number of its primaries is reduced to nine; the mandibular symphysis is well developed, and the palatine and facial part of the skull is highly specialized, and so is the digestive canal. Furthermore, the plumage of the young is essentially like that of the adults. It even seems as if the development of the brain can be no serious objection against the finches, since, according to Tiedemann, as quoted by Newton, the proportion which the brain bears to the body in the European goldfinch (*Carduelis carduelis*), and in the canary-bird (*Serinus canarius*) is as one to fourteen. The 'high' condition of the palatal structure is clearly demonstrated by the fact that in the typical Fringillidæ the moieties of the vomer are well coalesced as early as the middle of incubation.

The above theory may be supported by additional reasons, but here is not the place to go further into detail. There remain to be said only a few words in regard to the characters by which the Passeroideæ are usually subdivided. The arrangements

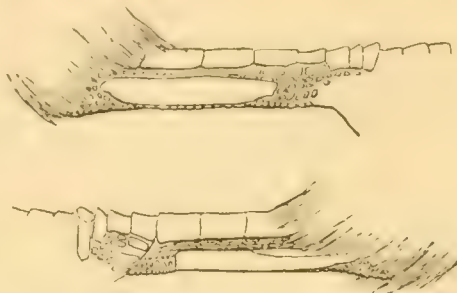


FIG. 234. — Right tarsus of *Corvus*: inner (above) and outer views (below).

of this vast multitude of forms are confessedly anything but natural. Several single characters have been employed, but in every case the result has been that some forms were separated from their nearest allies, the relationship of which is so clear that it cannot be disputed; hence the systematist was compelled to take them into a group from which the characters given excluded them and made them 'exceptions.' It has repeatedly been attempted to establish sections higher than families, but without success. Wallace's proposition to employ the number of primaries as an easy means of separating large groups has received considerable favor, but the fact that none of the groups are without 'exceptions,' and that nine and ten primaries may occur within

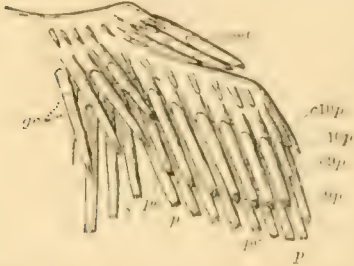


FIG. 235. — Primaries and first secondaries of wing of fledgling *Plectrophenax* enlarged one and one half times, from above; *a*, alula; *c9p*, covert of penultimate, and *c10p*, covert of last primary; *gc*, greater coverts; *p*, primaries; *9p*, penultimate primary; *10p*, ultimate (first) primary; *s*, secondaries.

the same genus, makes the scheme valueless in a natural classification. The fact is, really, that the tenth (first) primary is not absolutely wanting in the 'nine-primaried' Passeres, but its size is so extremely reduced as to become quite or nearly invisible in the old birds, the more so since its position is also slightly changed, as it is forced up on the upper surface of the wing. Not so in the young, however. In a very young specimen of the snow-flake (*Plectrophenax nivalis*), a 'nine-primaried' species, now before me, the outermost (tenth) primary is plainly visible in its natural position, and with the corresponding great covert in its proper place, that is, in the interval between the ultimate and penultimate primaries, as shown in the accompanying cut (Fig. 235). From this will be easily perceived how perverse is the method of counting the primaries from the edge of the wing, since, in nine-primaried birds, the feather which is usually called the first in reality corresponds to the second of the ten-primaried species. By counting from the secondaries, no difficulty is experienced.

Since Cuvier's days, however, the Passeres have most commonly been gathered into groups according to the shape of the bill, and the section names ending in *-rostris* are familiar to everybody. For convenience they have been employed even in the latest systems, though confessedly only in default of something better. Believing that their retention is a decided obstacle to a natural arrangement, we shall take no further notice of them. It may be proper to enumerate them, however, since they play a considerable rôle in the ornithological nomenclature. According to Selater's arrangement of the laminipantar Passeres, these sections are as follows:—

- Dentirostris*, comprising thrushes, wrens, warblers, tits, Old World fly-catchers, pipits, etc.;
- Latirostris*, for the swallows;
- Curvirostris*, creepers and nuthatches;
- Tenuirostris*, sun-birds, honey-suckers, etc.;
- Conirostris*, finches, weaver-birds, tanagers;
- Culirostris*, crows, pies, jays, starlings, grackles, birds-of-Paradise, etc.

We do not claim, however, that the arrangement to be applied in the following is quite natural in all its detail. The exact affinities of many forms are as yet very obscure, or in dispute, while in many other instances we are still ignorant of the nature of some important characters, whether we shall regard them as generalized or specialized features. But we must warn against any criticism charging unnaturalness on

account of distantly related forms having been placed in juxtaposition in the linear sequence. The allied forms must be looked for at the root of each series, not at the end. Regarding our system as a tree, it is our plan to place it on paper by working from the stem up the first branch to its top, then descending to the base of the next branch, to again work upwards, and so on until the top of the last branch is reached. In cases of reasonable doubt, however, we propose to give the conventional arrangement the benefit of the doubt.



FIG. 236. — *Alauda arvensis*, wood-lark (upper); *A. arvensis*, sky-lark (left); *A. cristata*, crested-lark (right).

This last paragraph is applicable to the family of the larks, the ALAUDIDÆ. They have sorely troubled systematists by apparently exhibiting characters of two groups as diverse as the Motacillidæ and the Emberizinae, and at the same time possessing a feature so unique within the present super-family as to prevent their proper assignment to either. This peculiarity consists in the holaspidean tarsi, technically making them scutelliplantar, the hind surface of the tarsus being broken up into scutes similar to those covering the front part. This is generally regarded as a generalized feature, hence the larks are usually placed at the bottom. We have a strong sus-

picion that this view is quite erroneous, but accept the present position at least provisionally. Additional characters of less importance are the length of the last secondaries, the ends of which nearly reach the tip of the folded wing; the usually strong and conical bill; the elongated and straight hind claw; the very short first (tenth) primary, visible in all, though extremely reduced in some; and the peculiar sandy-brown plumage longitudinally streaked with dusky. So general is the uniformity of the plumage that 'lark-colored' has become a technical term. This style is well illustrated in the accompanying cut, which represents three common European species, *Alauda arborca*, *A. arvensis*, and *A. cristata*. There are, however, several forms which show considerable differentiation in color, as, for instance, a number of pale sandy-colored desert-forms, among which the long-legged, long-billed *Certhilauda alaudipes*; the curious South African *Megalophonus apiatus*, with the nostrils not covered by the usual bristles, and a coloration highly suggestive of that of a quail; the black *Melanocorypha yeltonensis*, from western Siberia; the unspotted *Ammomanes phoenicura*, with the basal half of the tail rusty, and the tip blackish; the sparrow-like *Pyrhulauda grisea*, with the middle of the lower surface black. Several of the last mentioned forms have a somewhat lengthened first primary, while in some the secondaries are short as in most birds, a feature which reaches its maximum in the genus *Pterocorys*. Finally, we have to mention the shore-larks, or horned-larks (*Otocoris*), which are easily recognizable on account of the curious elongated tuft over each eye forming a kind of pointed hornlet. To us they are of special interest, since they are the only larks which occur regularly in this hemisphere; for the European skylark has only a right to a place in our fauna as a straggler to Greenland and the Bermudas. This latter bird is the most famous and familiar of the whole group, being one of the favorite migratory birds, the early arrival of which, in spring, is a welcome messenger from a milder sky in those countries where it makes its home. This, in connection with its marvellous song, has made the skylark a favorite with writers and poets, in this respect successfully rivalling with the nightingale. We quote from Yarell: "It is an inhabitant of all the countries of Europe, preferring cultivated districts, and particularly arable land. Here in early spring its cheerful and exhilarating song, fresh as the season, is the admiration of all. The bird rises on quivering wing, almost perpendicularly, singing as he flies, and even after gaining an extraordinary elevation so powerful is his voice that his wild, joyous notes may be heard distinctly when the pained eye can trace his course no longer; but an ear well tuned to his song can yet determine by the notes whether he is still ascending, stationary, or on the descent, for the strain is continued on his downward course till he approaches the ground, when it stops abruptly, and with a headlong dart the bird alights." The skylark likewise has a high reputation as a dainty for the table, and was formerly caught during the fall migrations in incredible numbers. Thus it is estimated that during the last century, in Leipzig alone, over five million larks were received annually; in 1854 there were brought to the London markets about four hundred thousands, and the official returns state that in 1867-68 more than a million and a quarter were taken into the town of Dieppe, France. These stupendous figures make it easy to understand that during the cold season the larks "do a considerable amount of damage to the autumn-sown wheat, if the ground be free from snow, and to such green crops as they may find." It is, therefore, a matter of congratulation, that the attempt to introduce the skylark into our country has not proved a success, as otherwise we should have had a repetition of our deplorable experience with the English sparrow.

The family Alaudidæ comprises more than one hundred species, especially characteristic of the plains and deserts of the Eurasiatic continent and Africa, while only a few forms, evidently recent immigrants, are found in the Australian and the Neogæan regions.

As already indicated, it is a question whether the general resemblance which the larks present to certain MOTACILLIDÆ, especially the pipits (*Anthus*), is anything more than a superficial analogy. At any rate, the similarity in external appearance between



FIG. 237. — European pipits (*Anthus*).

certain pipits and the typical larks is certainly astonishing, and he who attempts to distinguish between some of the species without looking closely at the hind side of the tarsus, or at the nostrils, which in the pipits are exposed, will find himself in a bad fix; for the resemblance not only affects the coloration both in general and in detail, but also the elongated hind claw, and the long inner secondaries. Even in the habits there is considerable likeness, for the pipits have a manner of singing when on the wing quite similar to that of the larks, though the song itself is much inferior. Physiologically

there is a great difference between the two groups, since the pipits molt twice a year, while larks only molt once. The pipits are nearly cosmopolitan, several Old World species being figured in the accompanying cut, and are pretty well represented in America. The Old World tree-pipit (*A. trivialis*) deserves special notice, since its arboreal habits are an exception to the rest of the species. Of other exotic forms we shall only mention the Ethiopian genus *Macronyx*, remarkable for its large feet, and especially interesting for its most extraordinary external resemblance to the dif-



FIG. 238. — *Enicurus leschenaulti*, Leschenault's fork-tail.

ferent species of the American meadow-larks (*Sturnella*), of quite another and remote family, a likeness which is nearly as striking as that of the typical pipits and larks, the more curious since we find species (for instance, *M. croceus*) which represent the yellow style of our North American meadow-lark, with black breast-patch, alongside another form, *M. anelia*, from Natal, which assumes the pinkish under-surface of *Sturnella defilippii*, of South America.

The wag-tails proper (*Motacilla*) structurally agree very well with the pipits, but

present quite a different style of coloration, black, gray, and white or yellow being distributed in continuous areas and not broken up into stripes or mottlings. Like the pipits, they are very partial to the neighborhood of water, running or stagnant, and like them they are nearly exclusively terrestrial in their habits, running gracefully and swiftly over the ground, putting one foot in front of the other, and jerking the long tail up and down. Their geographical distribution is noticeable, since no form is indigenous in the New World, the yellow wag-tail (*Budytes flavus leucostratus*) occurring in Alaska being only a slight eastern race of the typical European form, which but recently has extended its range into the northwestern corner of our continent.

A small group of anomalous birds, the exact position of which is nearly as doubtful now as it was some sixty years ago, when the first species was discovered, are next to be mentioned. The fork-tails, on account of a certain resemblance in form, color, and habits, have been placed by most authors near *Motacilla*; others have referred them to the immediate vicinity of the water-ouzel (*Cinclus*); while Mr. R. B. Sharpe has given them place as an 'aberrant group' in the Timaliidae, on account of the form of the wing, the first (tenth) primary being rather long and well developed. Under the circumstances, it seems to us preferable to keep them separate from the rest, and until a satisfactory place be found for them we shall designate them as ENICURIDÆ. Only eleven species, belonging to three genera, are known, their range being from the Indian and Chinese Himalayas down through the Burmese countries to the Malay peninsula and the islands of Sumatra, Java, and Borneo. The most characteristic species and the type of the genus *Enicurus* is figured in the accompanying cut, which needs no further comment, since the colors are black and white, as seen in the drawing. There is one feature of the coloration of these birds of uncertain affinity, which is of great interest, viz., the white tips to the rectrices. We call special attention to this fact, because we have recently seen it asserted that such a style of the tail-feathers is only found in birds with rounded or graduated tail. This 'exception' is the more remarkable, since *Microcichla scouleri*, which has a short and nearly square tail, has no such white marks at the end of the rectrices. As to their habits, Mr. H. J. Elwes remarks that "their motions are so active and lively that they form a conspicuous feature in Himalayan scenery, being usually found, either singly or in pairs, flitting rapidly from rock to rock by the side of the most rapid torrents. They appear to be very partial to the neighborhood of a waterfall or rapid. They make a large nest of moss and fibres, which is placed under a rock close to the water. Their food consists of insects, larvæ, water-beetles, and small shells."

Before leaving the Enicuridæ, however, I would like to record my suspicions that they are not laminiplantar or even oscinine at all. The tarsi are 'booted,' it is true, but the posterior aspect is rounded, and not sharp-edged, as in typical laminiplantar birds. In other words, I find the tarsus to agree very closely with that of the 'booted' species of *Pitta*, in the neighborhood of which I believe that the *Enicuri* will finally have to be placed, as soon as their anatomy shall have become known.

In their attempts at framing natural families among the Oscines, the different monographers have thrown out of the old-fashioned artificial groups which formerly were honored by that rank all the inconvenient forms which would not properly fit into the new scheme, without providing another or better place for them in the system. As they had to be accommodated somewhere, and as many systematists have a great horror of 'families' consisting of only a few genera or even a few species, all these heterogeneous forms were put into the great 'waste-basket' which has been

called the TIMALIIDÆ, or 'babbling-thrushes.' While taking a goodly number of forms out of this heterogeneous assemblage, we will yet have to leave enough in it to justify the epithet above, as this is manifestly not the place to attempt unravelling the tangle into which modern systems have brought themselves.

The Timaliidæ form quite an extensive group, consisting almost exclusively of tropical Old World types, which, speaking in a general way, may be said to resemble the true thrushes, differing chiefly in not having the anterior tarsal scutes fused, and in having their wings strongly concave, so as to fit closely to the body. With the exception of one pretty well defined group within the family, most of the birds which we include in it are very modestly colored, rufous being a very common ground-color, or with admixture with white, gray, and black. In this respect the 'babblers' show considerable similarity to the Formicaroidæ, offering another proof of how erroneous is the popular belief that the tropical birds must necessarily be brilliantly colored.

Out of the nearly four hundred and fifty species composing this family there will only be space to mention a few of the most prominent forms. The remarkable spine-tailed *Orthonyx temminckii*, from eastern Australia, is noteworthy for the fact that grave doubts as to its oscine nature were entertained until quite recently, when Forbes, in 1882, demonstrated its mesomyodian character. This bird also deserves to be mentioned on account of an anatomical feature which is unique, inasmuch as the left carotid (the only one developed, as in all Passeres) "is not contained anywhere in the subvertebral canal, but runs up superficially in company with the left vagus nerve to near the head, where it bifurcates in the usual manner." Another strange form, the true passerine nature of which has only been shown recently, is the Malayan and Papuan genus *Eupetes*, the type species of which, *E. macrocerus*, is said to have a great external resemblance to *Mesites*. The bill is long, and the head and neck are covered with very short velvety feathers, causing the neck to look disproportionately thin; over the eye a silky white streak.

There are many other genera, some of which resemble shrikes, others which look more like jays, others again which personate the thrushes or starlings. *Kenopia striata*, from the Malay Peninsula, in its coloration strongly recalls a *Dendrocolaptes*, but the feathers of the lower back are very long and soft, a feature characteristic of many true timaliine birds; it is carried to an excess in *Macronus ptilosus*, from the same country, in which, moreover, the shafts are broadened, stiffened, and white-colored. First in the Pycnonotinæ, bulbuls, or fruit-thrushes, are found more brilliantly colored species, among which we may mention the different species of *Pycnonotus*, brownish gray birds, with more or less blackish head, and easily recognizable by having the under tail-coverts brightly colored, either red or yellow. Another genus which is now referred to this group is *Irena*, containing the fairy bluebirds, brilliantly blue and black colored birds, as large as robins, and characteristic of the oriental region from central India eastward to the Philippine Islands. Another group, which has often been regarded as a separate family or sub-family, has also recently been united with the foregoing genera, viz., the green bulbuls (*Chloropsis* and allies), a small group of oriental fruit-eating birds of brilliant green plumage, on the head often adorned with blue, yellow, and black. The genus *Crinifer* is especially remarkable for the long and extremely thin hairs which protrude between the feathers of the head and hind neck, and for the very stiff bristles at the mouth angle.

Little is known about the habits of the timaliine birds. Of *Pycnonotus hæmorrhous* Captain Legge writes as follows: "The Madras bulbul affects gardens, com-

pounds, cinnamon plantations, the vicinity of roads, low jungle, open scrubby land, and the edges of forest. It is a fearless and very sprightly bird, most active and animated in its manners, erecting its conspicuous crest to full height as it sits on the top of a bush chirping to its companions. It locates itself in close proximity to houses, and not unfrequently builds its nest in verandahs, and is consequently a universal favorite with Europeans, who rate its attempts at singing so highly that it is styled by many the 'Ceylon nightingale.' As a matter of fact, however, its notes have but little music in them, but it is constantly uttering its quick chirruping warble, which, in the breeding season, is to a certain extent more melodious than at other times. Its food consists of insects, as well as fruit and seeds of all kinds, the berry



FIG. 239. — *Accentor modularis*, hedge-sparrow; *A. collaris*, Alpine accentor.

of the *Lantana* plant being a favorite diet, a fact which conduces to the propagation and spreading of this horticultural pest. In the evening little parties of bulbuls assemble, and after a great deal of excitement and chattering they choose a roosting-place in some thick bush or umbrageous shrub."

Of somewhat doubtful relation to the Timaliidæ are the African Eremomelinæ, nearly fifty species of warbler-like birds, which may perhaps be better placed among the Sylviidæ. Still more uncertain is the position of another group, which is often recognized as a separate family under the name of LEIOTRICHIDÆ. The 'hill-tits,' comprising nearly sixty species, peculiar to the Himalayas and the oriental region, have a varied plumage, often brightly colored, and with prominent markings on the wing. They feed especially on berries and insects. The best known species is the

red-billed hill-tit (*Leiothrix lutea*), by dealers in living birds often called 'the Japanese robin,' though not occurring at all in Japan. On account of its beautiful colors, its pleasant song, and its tame and gentle manners, it is often kept in confinement, and instances of its having bred in cage are now quite numerous.

But it is not only the species living in the tropics, and of difficult access, the relationship of which is obscure and disputed. In the accompanying cut are represented two European species, the hedge-sparrow (*Accentor modularis*), and the Alpine accentor (*A. collaris*), members of a very small group of birds, scattered over the Palearctic region, and chiefly noted for the somewhat sparrow-like inflection of the cutting edges of the bill. The former is a very modestly brownish-colored bird, and partial to hedges and bushes, light woods and gardens, while the Alpine accentor is richly tinged with rufous on the back, and very conspicuous for the beautiful black-and-white design of the throat. This species is found in the European Alps, above the tree limit, where in summer it lives among the rocks, coming down in winter into the valleys; allied species occur in all the high mountain ranges of the southern part of the Palearctic region. Various authors have placed these birds with the Old World warblers, the thrushes, the tits, the sparrows, the American bluebirds, or the babblers. We have followed the latter course, as quite non-committal, since leaving a bird among the Timaliidae means nothing more than saying that its true position is still unknown or doubtful.

In this country we usually designate the tyrant-birds as the 'fly-catchers,' a name, however, which properly should be restricted to the members of the Old World family, the MUSCICAPIDÆ. They are chiefly characterized by a broad, depressed bill, with heavy bristles at the gape, mostly scutellated lamellipantar tarsus, a short first (tenth) primary, and a spotted young plumage radically distinct from that of the adults. The propriety of regarding the fly-catchers as a group of family rank may well be questioned, however, at least as it is currently defined and adopted, since it seems to fade gradually into the Timaliidae on one hand, and into the Turdidae, or thrushes, on the other.

Two common European species, the spotted fly-catcher (*Muscicapa grisola*), and the pied fly-catcher (*Ficedula atricapilla*), are illustrated in the cut as well known members of the family, the former brownish gray, slightly spotted underneath, and both sexes alike, the latter, an adult male, pure black and white, while the female and the young are grayish. I am bound to say, however, that I am inclined to adopt Sundevall's view of the latter species and its allies, among which are the minute, rusty-throated *Erythrosterina*, as being only distantly related to the former. Within the conventional limits of this family are included about four hundred species, very different in structure and plumage, but all limited to the Old World. In the tropics the fly-catchers reach a great development, and many interesting forms, the names of which alone would take up too much space, occur. Yet we cannot pass by the Paradise fly-catchers (*Terpsiphone*) in silence, adorned as they are more after the fashion of a quezal than that of a bird-of-Paradise, with extremely elongated middle tail-feathers, measuring in some of these small birds not less than twelve inches. The old males, for instance, of *T. paradisi*, in their white plumage, with the crested glossy blackish-green head, are exquisite, but it takes considerable time before they attain this perfect plumage, according to the latest theories, as the young male is said to pass several seasons in the reddish brown dress of the female, even after having attained long tail-feathers. Other remarkable forms are the fan-tails (*Rhipidura*), a

numerous genus inhabiting the oriental and Australian regions, which have obtained their name from their habits of spreading out the tail to its full extent while darting after the insects. The Australian 'grinder' (*Sisura inquieta*) has been so called by the colonists on account of the peculiar voice, which is "something like that caused by a razor-grinder at work." This curious voice is not its call-note, however, but is only uttered when hovering over the ground like a small falcon, probably in order to attract the attention of the insects upon which it darts headlong.

On the whole, the habits of the fly-catchers are very uniform, or 'monotonous,' as

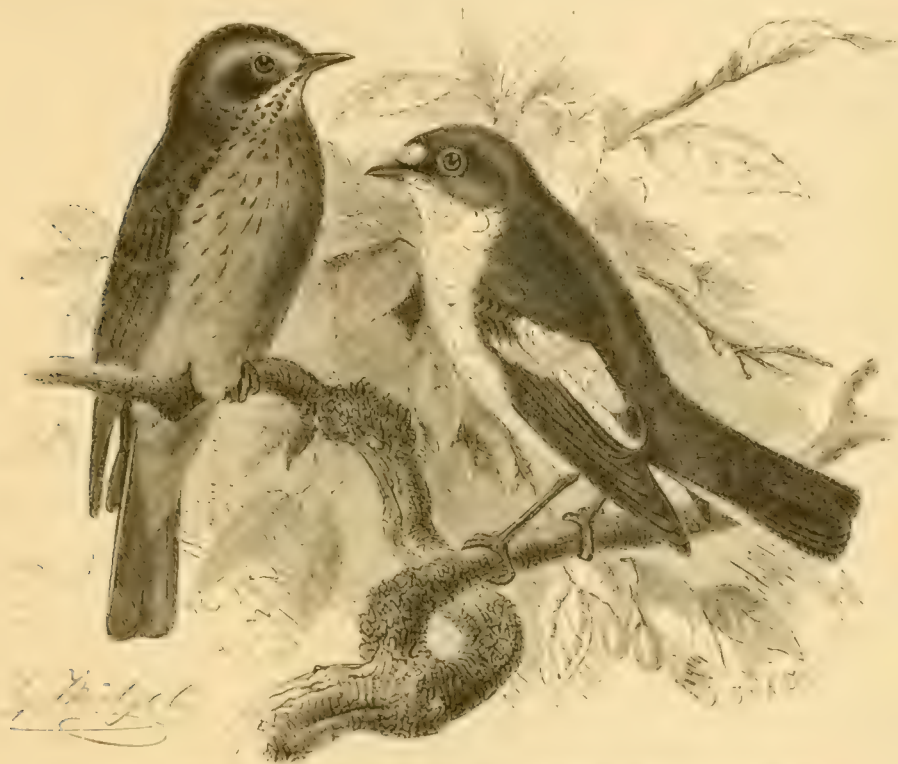


FIG. 240. — *Muscivora grisola*, spotted fly-catcher; *Ficedula atricapilla*, pied fly-catcher.

a recent author has called them. In nearly exclusively catching their prey while on the wing, they closely resemble the American tyrants, with which for a long time they were united in the systems.

Gradually the fly-catchers with the broad, depressed bills fade into the more narrow-billed thrushes, the central groups of which are characterized by a young plumage spotted with whitish or ochraceous, and usually by 'booted' tarsi. From the oldest genus, the family may be called TURDIDÆ, though embracing a number of forms which are often dignified as Sylviidæ, Saxicolidæ, etc. The limits of this 'family' are a matter of doubt, but a rough estimate will give about eight hundred species belonging to a bewildering number of genera. No wonder that a group of such extent is cosmopolitan in its distribution, for the Turdidæ occur from the bleak Arctic and Antarctic regions to the equator, not only populating the wide continents, but penetrating to the remotest islands, where they often specialize into very interesting gen-

eric forms, as, for instance, the thrush (*Nesocichla eremita*), which inhabits Tristan d'Acunha, an island in mid-Atlantic, "one of the most remote and isolated spots on the globe." The family is only scantily represented in America, the thrushes and some few allied forms being only a small proportion of the enormous number of Old World 'warblers.'

Some of these American forms, however, belong to the most interesting, among which, on account of their apparent relationship to the Old World fly-catchers, the solitaires or fly-catching thrushes (*Myadestes*) stand first. One species occurs in the middle and western parts of our country, though the headquarters of this genus is Central America and the Antilles, nearly every one of the mountainous islands being inhabited by a distinct species. They are known as exquisite songsters of very retired habits. An abstract of Mr. F. Ober's account of the 'invisible bird' of St. Vincent, one of the smaller Antilles, may not be out of place. Its systematic name is *M. sibilans*; it is blackish above and orange-rufous beneath, one of the most distinct species of the group. Mr. Ober writes as follows: "The local name of the 'Soufrière-bird,' from the French word *soufrière*, a sulphur mountain, an inhabitant of the volcano, has been obtained from the Caribs and the negroes, as the bird is rarely heard outside a gunshot limit from the crater. Its habitat is strictly mountainous, and I do not think it is ever found at a lesser height than one thousand feet above the sea; and in the dark ravines and gorges seaming the sides of the cone it finds a congenial retreat. It resembles a closely-allied bird of Dominica, the 'mountain whistler,' in many particulars, especially in its habits of seclusion, shyness, and melody of song. It is, however, much shyer than even the Dominica bird; and, while the latter seems to prefer the solitude of dark gorges more from a love of retirement than fear of man, the soufrière-bird is timid, even suspiciously watchful of man's presence, and flies from his approach. In its wild, sweet, melancholy music, it strikingly resembles the 'mountain whistler,' but the notes are different. From the dense thicket of trees bordering the trail around the crater this bird sends forth its mystic music, and darts away at the slightest indication of human proximity to its haunts. As the earth supporting the trees it inhabits is cut into every conceivable shape of hole, rut, and ravine, and as, moreover, the place swarms with monster snakes, the terror of the negroes, almost the only people crossing the mountain, it has been connected with the superstitions of the negro, and has ever remained the 'invisible, mysterious bird with the heavenly song.' The Indians avoided its haunts, and regarded with veneration this bird that filled the air with unearthly melody; for generations they have preserved the tradition of its existence, and vaguely associated it with the tutelary deity of the volcano."

Not distantly related are our lovely bluebirds (*Sialia*), a group which has been considerably knocked about in the systems. It is really rather isolated, and the only very nearly allied form is *Ridgwayia pinicola*, from the high pine woods of Mexico, a rare species of very limited distribution. It is colored very much like a bluebird in the first plumage, but is much larger.

It will be necessary to confine our remarks to such forms as are illustrated in the accompanying cuts.

In the first we have two European representatives of the genus *Turdus*, to which also belong our North American wood-thrush (*T. mustelinus*), and its many small allies. Nearest to these, and similarly colored, but with rusty under wing-coverts, comes the figure to the left, the song-thrush (*T. musicus*), the musical powers of which

are so well described by Macgillivray that we must quote his words: "Listen, and think how should you describe the strain so as to impress its characters on the mind of one who never heard it. Perhaps you might say that it consists of a succession of notes, greatly diversified, repeated at short intervals with variations, and protracted for a long time; that it is loud, clear, and mellow, generally sprightly, but at times



FIG. 211. — *Turdus musicus*, song-thrush; *T. torquatus*, ring-ouzel.

tender and melting. You might add that two birds at a distance from each other often respond, the one commencing its song when the other has ceased, and that sometimes several may be heard at once, filling a whole glen with their warbling. Listen again, and say what does it resemble?

" ' Dear, dear, dear,
In the rocky glen;
Far away, far away,
The haunts of men.

There shall we dwell in love,
 With the lark and the dove,
 Cuckoo and corn rail;
 Feast on the banded snail,
 Worm, and gilded fly;
 Drink of the crystal rill,
 Winding adown the hill,
 Never to dry.

“ ‘With glee, with glee, with glee,
 Cheer up, cheer up, cheer up; here
 Nothing to harm us; then sing merrily.
 Sing to the loved one whose nest is near.
 Qui, qui, qui, kween, quip,
 Tiurru, tiurru, chipiwi,
 Too-tee, too-tee, chiu choo,
 Chirri, chirri, chooe, e,
 Quin, qui, qui.’ ”

“No more, pray: the thrush’s song is inimitable and indescribable. It is heard at all seasons in fine weather, but especially in spring and summer, particularly in the early morning and about sunset. But it is not in sunshine only that this gentle songster warbles its wild notes; for often in the midst of the thick rain it takes its stand in some sheltered spot, under the cover of a projecting crag or stone, and for hours, perhaps, amuses itself with repeating its never-tiring modulations.”

The other species, the ring-ouzel (*T. torquatus*) is more confined to mountainous regions, and is one of the largest and finest thrushes, black, with a conspicuous white collar. On account of its black color it is generally believed to be closely allied to the European blackbird (*Merula merula*). This is a great mistake, however, as it does not even belong to the same genus, and its nearest relative is the spotted missel-thrush (*T. viscivorus*). The blackbird, on the other hand, is congeneric with our American robin (*M. migratoria*), which it is extremely like in form and habits; but, as the name indicates, it is black all over. The English robin (*Erithacus rubecula*), again, is much smaller, being not larger than our bluebird, and has longer legs, but is not otherwise very different from its American namesake. Through this form we are led to the subjects of our next illustration, the two famous species of nightingales, the western (*Luscinia luscinia*) to the left, and the larger and eastern species (*L. philomela*) to the right, both inhabiting Europe, and nearly peculiar to that region. Respecting the former, Mr. Seebohm says: “The nightingale is a very skulking bird, frequenting the dense undergrowth, hopping restlessly about the cover, and, when alarmed, it instantly finds shelter amongst the tangled vegetation. The song of the nightingale has possibly been over-praised. Its beauties have been the poet’s theme for ages; and men have immortalized it who have probably never listened to its strains. Fiction has described the bird as leaning against a thorn, and has thus explained the cause of its singularly melancholy notes. The nightingale’s song, nevertheless, is not equalled by that of any other bird; and the volume, quality, and variety of its notes are certainly unrivalled. It is impossible in words to convey its delightful strains to the reader; the bird’s haunts must be visited, and its sweetness listened to there. The nightingale does not always sing in the hours of night, as is very popularly believed to be the case, and it may be heard warbling at all hours of the day. Neither is the nightingale the *only* bird that sings under a starlight sky.” The nightingale is dull brownish above, shading into whitish or grayish underneath, and in the exterior has

has nothing to recommend it but its elegant and graceful form. In this plainness of dress they are equalled, however, by some Central American species of the genus *Catharus*, one of which, *C. gracilirostris*, is most astonishingly like the true nightingales, and travelers insist that their vocal powers are not inferior. On the other hand, the plate facing page 496 shows us two northern, nearly arctic songsters, of fine musical qualities, but also adorned with the most brilliant and exquisite colors of the throat, one, *Cyanecula suecica*, with the richest blue, the other, *Melodes calliope*, with



FIG. 242. — *Luscinia luscinia*, nightingale; *L. philomela*, thrush-nightingale.

a lovely scarlet, which, when the warbling bird faces the setting sun, shines with the lustre of an amethyst. The present writer can testify to the fitness of its name, the Kamtschatkan nightingale, for, although its song is not so melancholy, or quite as varied, as that of its western rivals, it certainly is a 'star' of the first order.

How nearly the thrushes and the true fly-catchers are related is illustrated by the three species depicted in our next cut, inasmuch as the left-hand figure without dispute is referred to the former, while the other two, by some recent authors, are con-

sidered members of the *Muscicapidae*, on account of their somewhat broader bills, shorter tarsi, and stronger rictal bristles. The wheatears (*Saxicola*) form a very marked group of peculiar coloration, black and white being the chief colors, often combined with gray on the back. Both these and the bush-chats (*Pratincola*) are exclusively Old World inhabitants, with the exception of *Saxicola ananthe*, the wheatear figured, inasmuch as it invades the North American fauna from both sides, over Iceland and



FIG. 243. — *Saxicola ananthe*, wheatear; *Pratincola rubetra*, whinchat; *P. rubicola*, stonechat.

Greenland in the east, and Alaska in the west, but its number in our continent is evidently yet very small. As it is very fond of rocks and stones, it is quite at home in the bleak northern regions, where it is a conspicuous feature by its light colors and its peculiar habits of simultaneously jerking up the tail and dipping the breast in a spasmodic sort of way, while emitting a curious call note, consisting of three loud clicks, often rendered by 'chick-chäck-chäck.' The genus is principally African, and southern species are mostly inhabitants of arid and stony deserts.

The Malurinæ form a characteristic group of warbler-like birds, chiefly Australian, though a few species also are found in South Africa and Madagascar. Our cut representing the emu-wren (*Stipiturus malachurus*), from Australia, illustrates one of the smallest and most curious of the group, the tail-feathers being stiffened, and only thinly supplied with barbs, so that they resemble emu-feathers; the color of the bird is brownish, with a blue throat, but many of the species are gorgeously colored, being in that respect not inferior to the brightest cotingas or tanagers. *Amytornis textilis*, with two allied species, also from Australia, belong here, wren-like birds of brown plumage, with curious whitish longitudinal streaks.

The bird to the left, in our next group, the faintail-warbler (*Cisticola cisticola*), is in Europe the only representative of the tribe of the grass-warblers, which to us is



FIG. 241. — *Stipiturus malachurus*, emu-wren.

of great interest, as it contains some of the most skilled bird architects, among others the remarkable tailor-birds. In his work on Indian birds' nests and eggs, Mr. A. Hume gives a full account of the structure of the nesting habits of *Sutoria sutoria*, from which we make the following selection: "The Indian tailor-bird breeds throughout India and Burmah, alike in the plains and in the hills, up to an elevation of from 3,000 to 4,000 feet. The nest has been often described and figured, and, as is well known, is a deep soft cup enclosed in leaves, which the bird sews together to form a receptacle for it. I quote an exact description of a nest which I took at Bareilly, and which was recorded on the spot: 'Three of the long ovato-lanceolate leaves of the mango, whose peduncles sprang from the same point, had been neatly drawn together with gossamer threads run through the sides of the leaves and knotted outside, so as to form a cavity like the end of a netted purse, with a wide slit on the side nearest the

trunk, beginning near the bottom and widening upwards. Inside this, the real nest, nearly three inches deep and two inches in diameter, was neatly constructed of wool and fine vegetable fibres, the bottom being thinly lined with horse-hair. In this lay three tiny, delicate, bluish-white eggs, with a few pale reddish-brown blotches at the large end, and just a very few spots and specks of the same color elsewhere.' I have often seen nests made between many leaves, and I have seen plenty with a dead leaf stitched to a yet living one; but in these points my experience entirely coincides with that of Mr. A. Anderson, whose note I proceed to quote: 'The dry leaves that are sometimes met with attached to the nest of this species, and which gave rise to the



FIG. 245.—*Cisticola cisticola*, fantail-warbler; *Cettia cetti*, Cetti's bush-warbler; *Aerocephalus schanbæus*, sedge-warbler.

erroneous idea that the bird picks up a dead leaf, and, surprising to relate, sews it to the side of a living one, are easily accounted for. I took a nest of the tailor-bird a short time ago (11th July, 1871) from a Brinjal plant (*Solanum esculentum*), which had all the appearance of having had dry leaves attached to it. The nest originally consisted of *three* leaves, but two of them had been pierced (in the act of passing the thread through them) to excess, and had in consequence not only decayed, *but actually separated from the stem of the plant*. These decayed leaves were hanging from the side of the nest by a mere thread, and could have been removed with perfect safety.' The ground color of the eggs is either reddish-white or pale bluish-green. Of the two types, the reddish-white is the more common, in the proportion of two to one.

The parent birds that lay these very different looking eggs certainly do not differ; of this I have positively satisfied *myself*." The tailor itself is a small bird of warbler size, with a graduated tail, and the central pair of rectrices considerably lengthened beyond the others, in the male; it is olive-green above, with the crown of the head pale brick-red, while the whole under surface is yellowish-white.

We have now arrived at the true Old World warblers (*Sylviinae*), the most promi-



FIG. 246. — *Locustella fluvialis*, *L. naevia*, and *L. luscinioides*, European grasshopper warblers.

nent European representatives of which are found delineated in the cut already referred to under *Cisticola*, as well as in the two following ones and one on the plate facing p. 496. All of them are dull-colored, gray or brownish, and we shall therefore dispense with any description of their appearance, reserving the space for a few remarks on their most salient peculiarities.

Cettia cetti, the upper figure on page 500, belongs to a group of warblers characterized by having only ten tail-feathers. They are chiefly central Asiatic, but the species in question inhabits the Mediterranean region.

The third bird in the same cut is the sedge-warbler (*Acrocephalus schoenobaenus*), one of the commonest species of this genus in Europe, breeding among sedges and reeds, or in the willows of marshes, and by the water-side as far north as Tromsø in Norway. In contradistinction to the following group, the reed-warblers, as they are called generically, are possessed of considerable powers of song, while the name of the grasshopper-warblers (*Locustella*) clearly indicates the character of their musical gifts. Three European species are figured in our cut, all of which inhabit marshy districts and reed-beds. Their habits are said to be very skulking and partly nocturnal. My own experience in Kamtschatka with a near ally of *L. naevia*, viz., *L. hendersonii*, is very different, and deserves a place here.

It was, as I thought, under rather peculiar circumstances that I made the first acquaintance of the grasshopper-warbler. From what I had read about the habits of allied species, and conjectured from the manners of *Acrocephalus ochotensis*, I listened for this bird about and after sunset, wherever willows were abundant, in the marshy valley bottoms. I recollected the many poetical accounts of ornithological enthusiasts waiting in the wet swamps for the moon's rising over the white vapors, when the males of *L. naevia* would commence their strange chirping, and, invisible to the bewitched naturalist, mock round him like mischievous elves, now pitching their ventriloquous notes to the left, now to the right, until the gunning poet, in bewilderment and despair, sends a shot at random in the direction from whence the creaking thrills seem to proceed. So I tried patiently to get enchanted, bewildered, water-soaked, and mosquito-bitten, too; but no *Locustella*!

It was a very hot day in the summer of 1882, in fact the last day of June, that I took an ornithological morning ramble to a broad valley just behind the rounded hills upon the sloping base of which Petropaulski is situated. The weather had been dry and warm for a considerable time; the vegetation was longing for rain, and the soil was gray and dusty. At last I determined to return; the tropical rays of the sun at noon had silenced all birds, and the only living being in the neighborhood not seeking the cool shade was the mosquito-phobious naturalist. Suddenly I was struck by the vigorous and rather protracted chirp of a heat-despising cricket. Something in its note led me to wish to get hold of the producer, so I cautiously proceeded in the direction of the sound. Zirrrrrr.....! But who describes my astonishment when I found that the supposed cicada was a small bird facing the sun from the top of a broken and dead birch! As he did not mind the noise I made when breaking my way through the five feet high grass, if I only took care to stop whenever he interrupted his curious love-song, his fate was soon sealed. It is needless to say that I now became an attentive listener to the grating sounds of the locusts, and half an hour later I was rewarded by another male, which I shot from the outer branches of a leaf-clad *Betula ermani*.

The Old World warblers (*Sylvia*), as we are obliged to term them in contradistinction to our American nine-primaried warblers, are very interesting on account of their geographical distribution. It is very generally asserted that the western Palearctic region, or the European sub-region, have no characteristic birds of their own. The warblers proper, however, seem to have their headquarters in the region surrounding the Mediterranean, while quite a number inhabit central and northern Europe without extending into Siberia, though several southern species breed as far east as Turkestan. Most of the migratory species winter in Africa. The plate facing page 496 illustrates two southwestern species, *Agrobates galactotes*, the rufous warbler,

easily recognizable by the sub-terminal dark band on the tail, a native of the Spanish peninsula and North Africa, and *Sylvia orphea*, which extends its range a little further north. The latter is not unlike the black-cap (*S. atricapilla*), the lower figure on this page, gray, with the upper part of the head black, one of the commonest and best-known warblers of Europe, in Scandinavia ranging north to 69° north latitude. The black-cap is highly esteemed for its melodious song, and therefore often held in confinement. Says Mr. Dixon: "You hear a soft, plaintive note, sounding as though its author were a hundred yards away; gradually it rises in its tone; you think the bird



FIG. 247.—*Sylvia nisoria*, barred warbler; *S. salicaria*, garden warbler; *S. atricapilla*, black-cap.

is coming nearer; louder and louder become the notes, till they sound as if the black-bird, song-thrush, wren, robin, and warbler were all singing together. You perchance cast your eyes into the branches above, and there see the little black-capped songster; and, after watching him, find that all these lovely notes, low and soft, loud and full, come from his little throat alone, and when at the same distance from you — so great are his powers of modulation." The two other species represented in the same cut are also well-known European warblers, *S. nisoria* being one of the largest and most distinctly-marked species. Its breeding range seems to be very peculiar, since it is only known to breed in a rather narrow belt from southern Sweden through Germany,

south Russia, Persia, and Turkestan, wandering southward in winter into Africa. It is a very shy and skulking bird, and may therefore easily be overlooked.

Our last picture of sylvine species represents birds of which allied species also occur in this country. The upper figure is a Siberian willow-warbler, related to *Phylloscopus borealis*, a comparatively recent immigrant into Alaska, where a small breeding colony has settled, the members of which in fall migrate southward through eastern Asia. In general aspect the willow-warblers resemble the kinglets (*Regulinae*), which are easily distinguished by their yellow and red — nearly tyrannine — crown-patches, and by having booted tarsi. Their exact position is still a matter of some



FIG. 218. — *Phylloscopus superciliosus*, yellow-browed willow-warbler (upper figure); *Regulus ignicapillus*, fire-crest; *R. regulus*, gold-crest.

uncertainty, and many authors refer them to the tits. The lower figure to the left is the European fire-crest (*Regulus ignicapillus*), in a cut indistinguishable from our North American *R. satrapa*. The gold-crest (*R. regulus*) is the other European species.

It was evidently a step towards a natural arrangement when lately the dippers and the mocking-birds were removed from the thrushes and associated more or less intimately with the wrens; and probably the *Chamaea* should not be kept outside of this assemblage. I may also remark here, as we have just finished the *Sylviidae* without mentioning the North American *Poliophtilinae*, that I regard the latter as closely allied to the mocking-birds, and that I consequently refer them to the family *Minidae*. It seems advisable for the present to retain the conventional family names.

The general aspect and the habits of the dippers, which alone compose the CINCLIDÆ, are alike curious. They are birds of the size of a thrush, have short concave wings, as the Timaliidae, a stumped tail, like some formicaroid birds, and a covering of down underneath the contour-feathers, like a water-bird. The oil gland, too, is very large, as in the latter, and serves the same purpose, for the dippers are as expert divers and as much 'water-birds' as most of those commonly so called. They are among the Oscines what the kingfishers are among the Picarians; but while the latter dart headlong into the water after their prey, like terns, the dippers dive like loons, but without jumping, and frequent rocky and foaming rivulets in search of their food, which consists of water insects, and, occasionally, of fish spawn. But while thus living the life of a water-bird, the dipper proves his right to be ranked with the highest organized birds, the 'songsters,' by its cheerful warble, which it keeps up all the year round, in winter as well as in summer. The dipper nests near the rushing waters of a mountain stream. The structure is large and domed, with an entrance hole on the side, and is firmly constructed of leaves and externally clad with green moss, so as to make it most difficult to discover among the mossy rocks, where it is located often so near the water's edge that the spray keeps it constantly wet. On the whole, the dipper, both in appearance, movements, nest-building, etc., is a gigantic wren adapted to a life in and at the water. Only one genus (*Cinclus*) is known, the species of which have a very curious geographical distribution, in some respects resembling that of the super-genus *Ceryle* among the kingfishers, for the dippers are found in greatest abundance in the Palearctic region, whence we trace them into North America, where one species is found in the Rocky Mountains down through Mexico and Guatemala, and one in Costa Rica and Veragua, the genus to reappear again in the high mountains of South America, three species being found there, among which is the recently-described *C. schulzi*. There are three styles of coloration in this genus: some species, of which the North European dipper, or water-ouzel (*Cinclus cinclus* — *C. melanogaster*), is typical, with dark abdomen and pure white breast; others, like our North American species (*C. mexicanus*), are dusky all over; while the South American species, and one Asiatic species (*C. leucogaster*), are white beneath, recalling the young plumage of the other species. This fact is noteworthy, as bearing upon the evolutionary history of the genus, since it indicates that the Neotropical forms are most like the ancestral stock. Hence we may conclude that the genus *Cinclus* immigrated into South America before the all dusky style had developed, or that South America is the cradle of the genus, since it is very improbable that the present coloration of the South American species should be due to reversion.

That the dippers should have originated in the Neotropical region seems not so extraordinary when we consider that this region is the great headquarters of the wrens, or TROGLODYTIDÆ, whence a few forms have scattered themselves through North America to the Oriental and the Palearctic regions. The absence of both families in Africa and in Australia is highly suggestive.

Prof. S. F. Baird was the first to discover and announce the curious fact that some of our western wrens have *taxaspidæan* tarsi. Of the genus *Salpinctes* he says: "It is, however, especially peculiar among all its cognate genera, by having the usual two continuous plates along the posterior half of the inner and outer faces of the tarsus divided transversely into seven or more smaller plates, with a naked interval between them and the anterior scutellæ. At the upper end of the outer plate these divisions or lines of junction are obsolete, becoming more distinct below, and near the

inferior extremity the plates are reduced to oval scales. The plate along the inner face is also divided into two or three plates, sometimes more, usually less, distinct than on the outer." Dr. E. Coues, in finding, as he thought, a similar arrangement in *Campylorhynchus*, went so far as to assert that "these points . . . go to show that their position in that family [Troglodytidae] is not assured," and to base a sub-family chiefly upon this character. There is no need of such a proceeding, however, for I have examined the tarsus of quite a number of *adult* cactus-wrens, and found them to be absolutely typical laminiplantar. Dr. Coues must have examined an exceptional specimen or a *young* bird, for in the latter the division of the hind plates is present and quite conspicuous. This very fact shows plainly that there is no essential difference between the taxaspidæan and the laminiplantar tarsus, the latter being simply a development of the former, just in the same way as the 'booted' tarsus is a development of the regular anteriorly scutellated tarsus, as shown by the division of the anterior plate in the young thrushes. The case, besides, is not unique among the Oscines. As well might we doubt the acromyodian character of the raven (Fig. 234), and taxaspidæan tarsi are found in several forms belonging to the Pycnonotinae, Oriolidæ, Prinonopinae, etc., the actual position of which cannot be doubted.

The general habits of the wrens are so well known that we shall only introduce a brief sketch by Mr. H. D. Minot of the cañon wren (*Catherpes conspersus*) as observed by him in Colorado: "At Manitou, local about cañons and rock formations, dodging, fluttering, and creeping about cliffs and caves. Easily recognized by its white throat and rich yellowish brown tail, and by its notes, — a peculiar insect-like chirp, and a delightful song of falling whistles, not loud or intense, but somewhat ecstatic, as if the bird hurried through till out of breath. After early June this song is not often to be heard. June 8, I found a nest and five fresh eggs. The nest was in the roof of a cave, about ten feet from the ground, in a niche or pocket, with an opening so narrow, vertically, that I could neither look in nor introduce my hand. Fortunately, however, the rock was so soft that I easily removed the bottom slab on which the nest rested. This, as one looks down upon it, suggests the eastern wood pewee's. It is composed of twigs, stalks, and bits of leaves, surrounded by a few loose sticks, and thickly felted with down, silk, and a few feathers."

An interesting troglodytine genus is the Indian *Pnæpyga*, with booted tarsi, like the dippers, and very short tail, which is invisible, being completely hidden by the tail-coverts and the feathers of the rump.

The so-called ground-tit, or perhaps better wren-tit (*Chama fasciata*), a remarkably isolated form both as to characters and habitat, being confined to California, has very little in common with the true tits except the very long, soft, and lax plumage. A special family, CHAMÆIDÆ, has been established for it, but I see no reason for separating it so far from the Troglodytidae, from which it seems to differ chiefly by the presence of strong rictal bristles, and, accordingly, I am most inclined to regard the Chamæinae only as a sub-family of the wrens. Their habits seem also to be very wren-like, but the information is somewhat scanty. Here is what Dr. J. G. Cooper says about them: "This interesting link between the wrens and the tit-mice is common everywhere west of the Sierra Nevada, on dry plains and hillsides covered with chapparral and other shrubby undergrowth, but is not found in the forests. It is one of those birds that can live where there is no water, except occasional fogs, for six or eight months together. In these dreary 'barrens' its loud trill is heard more or less throughout the year, but especially on spring mornings, when they

answer each other from various parts of the thickets. They have a variety of other notes resembling those of the wrens, and correspond with them also in most of their habits, hunting their insect prey in the vicinity of the ground or on low trees, often holding their tails erect, and usually so shy that they can only be seen by patient watching, when curiosity often brings them within a few feet of a person; and, as long as he sits quiet, they will fearlessly hop around him as if fascinated."

The mocking-birds (MIMIDÆ) are hardly entitled to family rank independent of the Troglodytidae, from which they chiefly differ in having well-developed bristles at the mouth, and in being on an average somewhat larger, though the smaller mocking-birds are not so large as the largest wrens. Like all the birds of the present group they are eminently American, and seem to have the centre of their distribution in Central America, the West Indian Islands, and the southwestern United States. The mocking-bird (*Mimus polyglottus*), the rival of the nightingale for the 'championship of the world' as a songster, the cat-bird (*Galeoscoptes carolinensis*), and the brown thrasher (*Harporhynchus rufus*) are representative birds of this family, and their song and habits too familiar to American readers to require further notice in this connection.

Whether the place here assigned to the Polioptilinae, or gnat-catchers, is correct may perhaps be questioned, but I think it safe to say that its position with the Mimidæ is more satisfactory than either with the Sylviidæ, Paridæ, or Mniotiltidæ. Indeed, I see little to separate them from the mocking-birds except the slightly more depressed bill and the size, the gnat-catcher belonging to the smallest of passerine birds. Muscicapine relationship has been suggested, but the form and position of the nostrils opposes such a view, as does also the geographical distribution, *Polioptila* being exclusively American, and the Muscicapidæ exclusively Old World forms. However, I may quote what Mr. R. B. Sharpe says about the question:—

"I believe that the most natural position for the genus will be in the vicinity of the muscicapine genus *Stenostira*, to which, both in form and style of coloration, *Polioptila* bears a striking resemblance, as has already been pointed out by Bonaparte, Selater, and other ornithologists. Should this classification turn out to be correct, it will afford another instance of the affinity of the avifauna of North America with that of South Africa, as already noticed in the occurrence of *Petrochelidon spilodera* at the Cape, a close ally of *P. pyrrhonota* [*P. lunifrons*] of North America." I may here remark, that the swallow genus *Petrochelidon* is found both in South America, Australia, India, and South Africa; that the swallows are very uniform both in form and coloration all over the world; that they are the fastest travelers of all passerine birds; consequently the similarity between the American and the African species is not so extremely surprising. On the other hand, the true fly-catchers are very polymorphic, and the distribution of the gnat-catchers and the *Stenostira* so disconnected that I prefer to regard the former as nearly related to their countrymen, the mocking-birds, especially as character of structure or coloration seems to make such a view untenable. The habits do not point either way, so far as I know. The gnat-catchers, a little over a dozen species, belonging to one genus only, inhabit all parts of America except the most southern and most northern portions.

Contrary to the general run of passeroid families, that of the swallows, the HIRUNDINIDÆ, is as well defined and isolated as any of the picarian families, at least externally. They are possessed of extremely long and pointed wings, with nine primaries; the feet are reduced very much in size; the bill is short but extremely broad, and the

gape split to near the eyes, but without bristles. Altogether they resemble closely the swifts (*Micropodidæ*), though structurally they are very different, and the distinguishing marks have already been pointed out (cf. page 437). *Inter se*, the different species of swallows vary but very little, and no intermediate forms are known which directly connect them with some other family, or indicate their line of descent. But different as they appear externally from other *Passeres*, nothing is found internally or even in their pterylography that will justify their being far removed from the forms hitherto treated of. Says Professor W. K. Parker: "In this remarkable group of tender-billed gaping *Passeres*, there is not, as far as I am aware, a single aberrant

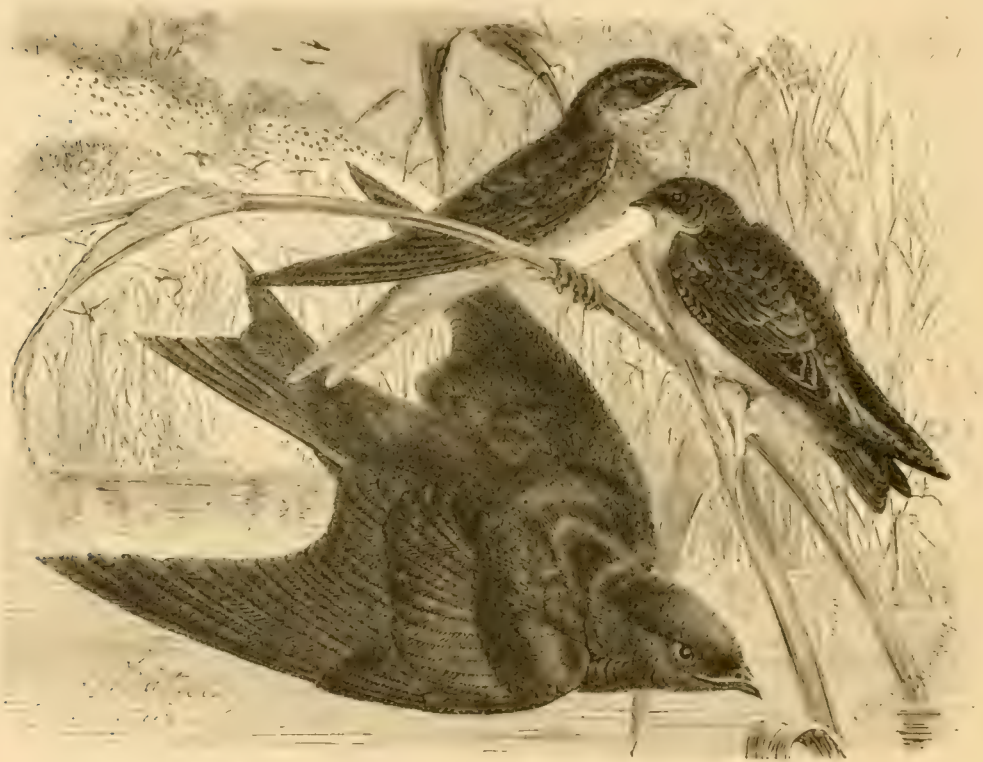


FIG. 249. — *Clivicola riparia*, bank-swallow; *Progne subis*, purple-martin.

character of importance. The skull, the skeleton generally, the digestive and the vocal organs — all these might belong to species of the genus *Sylvia*."

About one hundred species of swallows are recognized, distributed all over the earth except the very arctic and antarctic regions. Uniform as is their structure, so are also their habits, they being chiefly migratory, and feeding on flying insects which they catch on the wing. Their whole organization aims at great speed, and they spend the greater part of their life in the air, but rarely perching in order to rest. The rapidity of their flight is only surpassed by its perseverance, while the shortness of their feet prevent them from moving on the ground except in the most awkward manner. In regard to their nesting habits, the swallows may be divided in three groups: (1) Those which build their nests in hollows of any description, not dug out or prepared by the birds themselves; to this group belong different species of the

genus *Progne*, the white-bellied swallow, and some others, among which is the Australian *Petrochelidon nigricans*, which lays its eggs in a hollow tree or rock, without any nesting material; (2) those which dig their nest holes in banks of earth or sand, as, for instance, our common bank-swallow and the rough-winged swallows; (3) those which build nests of moist mud and clay; some of the latter rest the more or less open structure on some fundamēt, as most species of the genus *Chelidon*, while others only build it against a perpendicular wall of a rock or a house, the nest forming a section of a globe, *e. g.*, the well-known European martin (*Hirundo urbica*), with the feathered feet, figured on the plate facing page 508; other species add to the globe a long entrance tube, thereby giving the nest the form of a bottle or a retort, prominent examples being our cliff-swallow (*Petrochelidon lunifrons*), and the two European species figured on the plate already quoted, the red-rumped swallow, and the crag-martin.

Referring to the figures of different species of swallows accompanying this account, we only remark that the European barn-swallow (*Chelidon rustica*) closely resembles our North American species, from which it chiefly differs in having the under side whitish. In the cut representing our common purple-martin (*Progne subis*) (lower figure), and the bank-swallow (*Clivicola riparia*), the nest-holes of the breeding colony are visible in the river bank in the background. Similar in color, though perhaps not very nearly related to the latter bird, is our American rough-winged swallow (*Stelgidopteryx serripennis*), remarkable for the curious serration of the first (ninth) primary, the edge of the outer web in the male, caused by the shafts of the barbs ending in a sharp hook. This same peculiarity is also found in an African genus, *Psalidoprocne*, but otherwise the two genera are very different.

The series of families now to be treated of is probably a natural one, taken as a whole, though there may be considerable doubt as to certain forms really belonging here. Some may belong to the Timaliidae, properly defined, and others may really be fly-catchers, while one or more genera included in the families already disposed of may naturally come in here. These forms, however, will cause us little trouble in the present connection, inasmuch as the difficulty in properly locating them is the direct result of our ignorance concerning their structure.

Like most of the families to follow, the CAMPEPHAGIDÆ, or cuckoo-shrikes, ranging from India to Australia, have been knocked considerably about in the systems. They have a rather short and strong bill, somewhat broadish at the base, hooked and notched at the end. Very characteristic, however, is the structure of the feathers of the lower back and rump, the shafts of which are stiffened, a feature easily ascertained by running the thumb against the plumage nail down. Though tropical birds, their coloration is grayish or blackish, only a few forms being gayly decorated, as, for instance, most species of the genus *Pericrocotus*, the bright scarlet vermilion, or yellow and black species of which, in form somewhat resembling wag-tails, are peculiar to the Oriental region. Of the Indian large 'minivet,' Mr. Jerdan says that, "like the rest of the tribe, it goes in small parties, hopping and flying briskly about the branches, picking insects off the leaves and flowers. On one occasion only I saw it descend to the ground. It has a lively, constantly repeated, rather mellow call." The Bengal name, according to Blyth, is '*Sath sati kapi*,' meaning 'the beloved of seven damsels.'

The fork-tailed DICRUHIDÆ, or drongo-shrikes, form another Oriental family, which also spreads into Africa and Australia. The most noteworthy features are the shrike-like bills, the glossy black crow-like coloration, and the peculiar furcation of the tail,

which consists of ten rectrices only. In some forms the exterior pair of tail-feathers is curiously recurved and twisted. In *Dicranostreptus megarhynchus*, from New Ireland, the outer tail-feathers are extraordinarily produced, being nearly double the length of the bird's body, and in the genera *Blarina* and *Dissemurus*, from India and Malaya, they are ending in a racket or spatule, many of the species having curious frontal crests. We quote from Jerdon: "They are birds capable of strong, rapid, and vigorous, but not of sustained, flight; and they feed almost exclusively on insects, which they capture on the wing, or on the ground, or occasionally on leaves or flowers. They are a most characteristic feature of Indian ornithology; for, go where you will in India, you are sure to see one or more of the genus." In some



FIG. 250. — *Ampelis garrulus*, Bohemian wax-wing.

respects their habits resemble those of the tyrant shrikes, and the Europeans in India also call them 'king-crows,' a name analogous to that of our 'king-bird,' for their boldness. The following account of the habits of *Buchanga atra* is again from Jerdon: "The king-crow obtains his familiar name in this country from its habits of pursuing crows, and also hawks and kites, which it does habitually; and at the breeding season, especially when the female is incubating, with increased vigilance and vigor. If a crow or kite approach the tree in which their nest is placed, the bold little drongo flies at them with great speed and determination, and drives them off to a great distance; but although it makes a great show of striking them, I must say that I have very rarely seen it do so; and certainly I have never seen it fix on the back of a hawk with claws and beak for some seconds, as Mr. Philipps asserts that he has

seen. Occasionally others will join the original assailant, and assist in driving off their common enemy." Anatomically the drongos are remarkable as being the only *Passeres* in which the accessory semitendinosus is absent, their myological formula being AX.

Perhaps not distantly related to the shrikes, the wax-wings, and their few allies, the AMPELIDÆ will have to find a place somewhere in this neighborhood. A familiar example of this small group is the beautiful cedar-bird (*Ampelis cedrorum*) from North America. The other species occurring in our country (*A. garrulus*) is more northern in its distribution, and is also found all over the northern parts of the Old World. A very unique ornament in these birds is the horny flattened lamellæ-like ends of red sealing-wax appended to the shafts of the secondaries, and sometimes to the tail-feathers, as seen in the accompanying cut. The history of the Bohemian wax-wing is interesting for its gipsy-like wanderings, one winter visiting one country, next season another, often in enormous flocks, and usually with the intervals of many years, so that in former times their appearance was regarded as sure forebodings of war and pestilence, their arrival being dreaded as much as that of a comet. Another interesting feature of its ornithological history is the fact that this familiar bird for a long time eluded the search of the oologists; for its breeding habits and eggs, and even the places where it breeds, were unknown thirty years ago, until finally discovered in Lapland by Mr. Wolley, after a diligent search during four summers.

It would only be repetition of former statements in regard to doubtful families were we to say anything more about the position in the system of forms like the wood-swallows, or swallow-shrikes (ARTAMIDÆ), a small family of shrike-like birds from Australia, and adjacent islands, similar in habits, flight, and partly in appearance to the swallows. They are birds of sombre, dusky, or gray colors. A very peculiar habit of the Australian common wood-swallow (*Artamus sordidus*) is recorded by Mr. Gould's assistant, Mr. Gilbert, during his residence at Swan River, as follows: "The greatest peculiarity in the habit of this bird is its manner of suspending itself in perfect clusters, like a swarm of bees; a few birds suspending themselves on the under side of a dead branch, while others of the flock attach themselves one to the other, in such numbers that they have been observed nearly of the size of a bushel measure."

Had it not been for the generally accepted family term for the foregoing group we should have lumped them with the heterogeneous assemblage called the LANIDÆ, shrikes or butcher-birds, the typical forms of which are characterized by their stout and strongly hooked and toothed bill, which in some of the genera strongly resembles that of the *Accipitres*, without having the cere at base, of course.

In the types first to meet us, however, the bill is more straight, the coloration is crow-like, and altogether the *Gymnorhininæ* may be as nearly related to the ancestors of the crows as to those of the shrikes. A structural feature of their own is that the nostrils are placed very far forward, almost midway between base and tip of bill, are quite bare of either bristles or feathers, and have entirely ossified margins. The whitish blue color of the bill in some forms is also quite characteristic. Here belong the crow-shrikes, genera *Strepera*, *Cracticus*, and *Gymnorhina*, from Australia, *Cracticus*, also from the Austro-Malayan sub-region. A good example is given in the 'piping crow-shrike' (*G. tibicen*), figured on the plate facing page 510. It is black and white, with a bluish ash-colored bill, and of the size of a small crow. According to Gould, it is a bold and showy bird, which, when not harassed and driven away, greatly enlivens and ornaments the lawns and gardens of the Australian

colonists, and, with the slightest protection from molestation, becomes so tame and familiar that it approaches close to their dwellings, and perches round them and the stock-yards in small families of from six to ten in number. "Nor is its morning carol less amusing and attractive than its pied and strongly contrasted plumage is pleasing to the eye. To describe the notes of this bird is beyond the power of my pen, and it is a source of regret to myself that my readers cannot, as I have done, listen to them in their native wilds."

Somewhat timeliine in the fluffy plumage of the back, which forms a thick and soft covering of the rump, the *Malaconotrinae*, African and Indian forms, generally like shrikes, but often very gorgeously colored,—as for instance the brilliant cobalt blue *Cyanolanius madagascarinus*, from Madagascar, and the African *Laniarius*, varie-



FIG. 251. — *Lanius minor*, lesser gray shrike.

gated with orange, green, black, red, etc.,—lead us directly into the typical *Laniinae*. These, the true shrikes or butcher-birds, like the foregoing families, are strictly Old World birds, but a few forms closely related to species of the genus *Lanius*, from the eastern hemisphere, have also invaded the Neartic Continent, and become familiar with us. In coloration they closely agree with the species figured in the accompanying cut, the lesser gray shrike of Europe, which, on account of its shorter and less graduated tail, is often placed in the genus *Emmococtonus*. Like the members of the latter, the rufous shrikes, it is migratory, therein differing from the other gray species. A characteristic feature in the history of these birds is their habit of storing insects or mice for future use by fixing them on the thorns of the bushes and trees which they frequent. This peculiar habit in the shrikes of thus spitting their food, Mr. Seebohm

remarks, is probably caused by the birds not having sufficiently powerful feet to grasp their prey until torn in pieces by the sharply toothed bill. They therefore secure their food on sharp thorns, and are able then, if it be a bird, to pluck it, or if an insect or lizard or a mouse, to tear it to pieces. In places frequented by this bold little bird (*E. collurio*) it is no uncommon thing to see in the bushes the remnants of its meal — of *many* meals; for the bird will regularly retire to one place for its purpose.

It matters very little, under the present state of affairs, whether we style our American greenlets Vireoninæ or VIREONIDÆ; for, in spite of their olive color and small size, they are apparently nearly allied to the shrikes. But they are especially



FIG. 252. — *Sitta cæsia*, nuthatch.

interesting on account of being the only indigenous American forms of the whole series, at least so far, and the only one of which no member ranges into any part of the Old World. From a taxonomic point of view they are of considerable importance, inasmuch as they prove the comparative insignificance of the presence or absence of a first (tenth) primary as a means of subdividing the Passeroidæ into groups of higher value than the present so-called families, for of two species of greenlets, so nearly allied that nobody ever dared separate them, even generically, we may have one with a distinct spurious primary, while it has become quite invisible in the other.

The greenlets reach their highest development in the genus *Cyclorhis*, embracing at least a dozen species from Central and South America, remarkable for their stout build, and high, strong beaks.

Prof. W. K. Parker, from an examination of the skull of *Cyclorhis*, pronounces it "the large prototype of the little Chinese *Suthora*," and as he found that the latter has "a skull which comes nearer to that of the tits than any I have yet examined," he arrived at a conclusion, which he expressed by calling *Cyclorhis* "this large archaic tit." On the other hand, Mr. Sharpe refers *Suthora* and its allies to the Timaliidae. Still, I think that even on account of the external characters they might be placed as



FIG. 253. — *Egithalos caudatus*, long-tailed tit.

a sub-family under the PARULE, the tits. One of the most remarkable Passeres seems to be allied to *Suthora*, viz., the three-toed *Cholornis paradoxa*, which the celebrated French traveler, Abbe Armand David, discovered in western China. The unique feature of this bird is the suppression of the fourth, that is, the inner anterior toe.

The present family may be divided into two sub-families besides the Suthorinae, if we decide to keep them here, viz., the true tits and the nuthatches (Sittinae). The

latter are specialized forms adapted for climbing in the manner of woodpeckers and creepers; but the tail is not stiff, while on the other hand the hind toe is extremely developed. The bill is protracted, is somewhat wedge-shaped, and is applied as a hammer, somewhat after the fashion of woodpeckers, in opening nests and acorns; but it must also be remarked that the true tits open seeds, bugs, and other hard objects by hammering just in the same manner. The nuthatches are mostly referable to the genus *Sitta*, as typified by the European species (*S. cæsia*) figured in our cut. The group is small and faunally best developed in the Asiatic continent, though several very distinct species also occur in North America. These are characterized by having the cap colored differently from that of the back, though *S. villosa* from China comes near to our *S. canadensis* in that respect, and in the two Mediterranean species, *S. krueperi* and *S. whiteheadi*, the forehead alone is black. A very aberrant form usually referred to the present sub-family is the Madagascar red-billed nuthatch (*Hypositta corallirostris*), in which the bill is shorter and somewhat fly-catcher-like.

The true tits are also chiefly Old World birds, though we have numerous representatives in this country also; but here they are all dull colored, while some of the foreign species, for instance, the azure tit, from Siberia (*Parus cyanus*), pure white and sky-blue, the blue-tit of Europe (*P. cæruleus*), blue, white, and yellow, and the large Japanese tit (*P. varius*), with chestnut on sides and hind neck, are among the most beautiful and delicately tinted birds of the northern hemisphere. The tits generally breed in holes in trees, a noteworthy exception being the long-tailed tits, of which our cut shows us the North European form with the white head, *Egythalos caudatus*. They are extremely small; in fact, look like a minute ball of feathers, to which is appended a disproportionately long tail. The species figured is black and white, with the shoulders wine-colored, and the flanks tinged with the same color. Their nest is a very large and elaborate purse-shaped affair, hanging free, or attached along the back to the main stem of the tree, covered on the outside with fine lichens and moss, while the inside is lined with an enormous number of feathers — Gould once counted two thousand in a nest which he tore to pieces — the whole structure securely matted together with spiders' webs. In this warm purse is deposited a large number of eggs, often nine to eleven, but rare instances are known where sixteen or even twenty eggs have been found in one nest. When incubating, the bird sits with the tail bent over its back. In their habits, the long-tailed tits, or 'bottle-tits,' as they are often called on account of the bottle-form of the nest, are very restless and erratic, always in movement, and, like the other tits, they are gregarious to a great extent.

The true orioles, ORIOLEÆ, must not be confounded with the American birds which we generally designate by that name. The two groups resemble each other in coloration inasmuch as the prevailing color is yellow and black massed in great continuous patches, but structurally they are as different as a crow and a warbler. The true orioles are exclusively a tropical Old World family, quite nearly related to the crow-like birds, and cannot be removed from their immediate neighborhood. They are especially at home in the Oriental and Australian region, but several species also occur in Africa, and one at least also invades the Palearctic, being a regular summer visitor to southern and central Europe, though only rarely straggling to the British Islands. This is the golden oriole (*Oriolus oriolus*) represented in the accompanying cut. The adults are rich golden yellow and black, while the young birds are greenish,

lighter grayish beneath, and streaked with dusky on throat, breast, and flanks. Its song is very celebrated. To quote Mr. Seebohm: "Its voice is marvellously rich and flute-like. The call-note during the pairing season sounds like the words 'who are you' in a full, rapid whistle; and its song is a *wheet, li, vee-o*, whence its vernacular name in Holland of 'Kiel-i-vee-vo.' Some slight modifications in its song are apparently produced by prefixing or interluding its call-note. It is a pity the song is so short; for in quality it is scarcely exceeded by the song of any other bird." It feeds principally on insects and fruit, and may in the summer do considerable damage to the cherries.

We shall regard the family of PARADISEIDÆ, or birds-of-Paradise as composed of three distinct sub-families, the bower-birds, the long-billed Paradise birds, and the

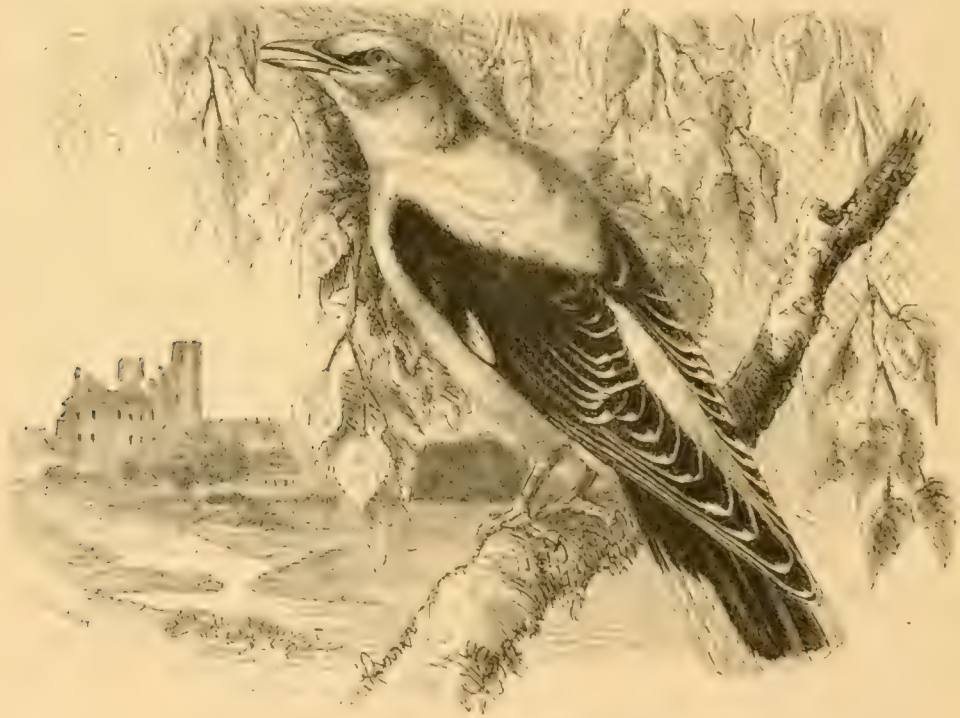


FIG. 254. — *Oriolus oriolus*, golden oriole.

true, typical Paradisæinæ. The first mentioned group is possibly linked to some Timaliine forms, with which Sharpe puts it, but the fact that a supposed bower-bird, *Sericulus xanthogaster*, was shown by Salvadori in 1876 to be the young of *Xanthomelus aureus*, one of the long-billed Paradise birds, is quite suggestive.

The bower-birds are peculiar to Australia and New Guinea, one of the oldest and best known species being the satin bower-bird (*Ptilonorhynchus violaceus*) figured on the plate facing this page. It is a large bird, of the size of a common magpie, the male purplish black, the female chiefly grayish green, underneath pale yellowish, barred crosswise with dusky. The bower-birds have received their name from the peculiar structures which they build apparently only for the purpose of pleasure as sporting-places where the males meet to pay their court to the females, and which are

constructed with such wonderful skill and taste, that we are forced to recognize the intellect manifested by them as only inferior to that of man in degree, but not in kind. Dr. Selater, in speaking of the birds of this species in the Zoological Gardens in London, says as follows: "Long before the construction of their nest, and independently of it, these birds form with twigs, skilfully put together and firmly planted in a platform of various materials, an arbor-like gallery of uncertain length in which they amuse themselves with the most active glee. They pursue each other through it; they make attitudes to each other, the males setting their feathers in the most grotesque manner, and making as many bows as a cavalier in a minuet. The architecture of the bower is excessively tasteful, and the ornamentation of the platform on which it stands is an object of constant solicitude to the birds. Scarcely a day passes without some fresh arrangement of the shells, feathers, bones, and other decorative materials, which they bring from long distances in the bush for this purpose. With the same object they immediately appropriate every suitable fragment placed within their reach when in confinement."

Still larger and more elaborate are the avenue-like "play-houses" of the *Chlamydodera*. Accompanying a bower of *C. nuchalis* now in the Museum of Comparative Zoology, in Cambridge, we learn, "were more than half a peck of the decorations with which the builders had adorned their place of assembly. These consisted principally of a large white univalve; the shell of a large land-snail, of which there were in all about four hundred; shining stones, principally flint-stones and agates; bright-colored seed vessels and pods; bleached bones of small quadrupeds, and other objects of interest."

But all these structures are completely overshadowed by the achievements of *Amblyornis inornata*, a plain rufous-colored bird, not larger than our American robin, and only recently discovered in New Guinea by the Dutch traveler and naturalist, Count Rosenberg. From an abstract of Dr. O. Beccari's account of the gardener-bird in the Arfak Mountains, on the western peninsula of New Guinea, in 1875, we make the following selection: "He had just shot a small marsupial as it was running up the trunk of a large tree, when, turning round in close proximity to the path, he found himself in front of a piece of workmanship more lovely than the ingenuity of any animal had ever before been known to construct. It was a cabin in miniature in the midst of a miniature meadow studded with flowers. Contenting himself for the moment with a brief examination of this marvel, he enjoined his hunters not to disturb it.

"After several days spent at Hatam in the preservation of specimens, at last, one morning, his crayon and box of colors in hand, he set out towards the habitation of the *Amblyornis*, and immediately applied himself to the task of making a sketch. At the time of his visit the proprietors were not at home, nor was he afterward able to ascertain with any certainty whether any cabin was frequented by a single pair, or by more; whether by more males than females, or the reverse; whether the males alone construct the huts, or whether the females aid in the work, or how far they may be the work of several individuals. That these cabins are used season after season is made probable from the fact that they are constantly being renewed and embellished.

"This bird selects for its hut and garden a spot on a level with the plain, having in its centre a small shrub, with a trunk about the height and size of a small walking-stick. Around the base of this central support, it constructs, of different mosses, a sort of cone about a span in diameter. This cone of moss seems to strengthen the

the central pilaster, upon the top of which the whole edifice is sustained. The height of the cabin is at least half a metre. All around, from the top of the central pilaster, and diverging outward therefrom, arranged methodically in an inclined position, are the long stems, their upper ends supported on the apex of the pilaster, and their lower resting on the ground, and thus all around, excepting immediately in front. In this way is made the cabin, conical in form, and quite regular in the shape the whole presents when the work is completed. Many other stems are then added and interwoven in various ways, so as to make a roof at once strong and impervious to the weather. Between the central pilaster and the insertion in the ground, there is left a circular gallery in the shape of a horse-shoe. The whole structure has a total diameter of about a metre.

"The long straw-like stems of which it makes use as rafters are the slender and upright branches of a species of orchid (*Dendrobium*), an epiphytal plant that grows in large tufts on the mossy branches of tall trees. They are as slender as fine straws, and are about half a metre in length. These stems retain their small and closely-packed leaves, which are still living, and continue to maintain their life a long while, as is the case with the greater part of the epiphytal orchids of the tropics, and there is little doubt that these sagacious birds select this plant on account of its vitality, purposely to prevent the decay of their dwelling."

"But the æsthetic tastes of our 'gardener' are not restricted to the construction of a cabin. Their fondness for flowers and for gardens is still more remarkable. Directly in front of the entrance to their cabin is a level place occupying a superficies about as large as that of the structure itself. It is a miniature meadow of soft moss, transported thither, kept smooth and clean, and free from grass, weeds, stones, and other objects not in harmony with its design. Upon this graceful green carpet are scattered flowers and fruit of different colors, in such a manner that they really present the appearance of an elegant little garden. The greater number of these ornaments appear to be accumulated near the entrance to the cabin. The variety of the objects thus collected is very great, and they are always of brilliant colors. Not only does the *Amblyornis* select its ornaments from among flowers and fruit, but showy fungi and elegantly-colored insects are also distributed about the garden and within the galleries of the cabin. When these objects have been exposed so long as to lose their freshness, they are taken from the abode, thrown away, and replaced by others."

As the first naturalist who saw the wonderful birds-of-Paradise, long-billed and short-billed ones, in their native forests, Mr. Alfred Russel Wallace's name is so closely connected with the history of these marvels of living beauty, and our knowledge of their habits and peculiarities is to such a degree due to his observations, that we shall have to follow his account of them as near as possible, using his own words, unable as we are to improve upon them. We must limit the remarks, however, to such species only of which we are able to present figures, viz., the two cuts inserted in the text, and the plate facing this page, though these only represent five species out of a total number of nearly three dozen.

When the earliest European voyagers reached the Moluccas in search of cloves and nutmegs, which were then rare and precious spices, they were presented with the dried skins of birds so strange and beautiful as to excite the admiration even of those wealth-seeking rovers. The Malay traders gave them the name of 'manuk dewata,' or God's birds; and the Portuguese, finding that the skins had no feet or wings, and not being able to learn anything authentic about them, called them 'passaros de sol,'

or birds of the sun; while the learned Dutchmen, who wrote in Latin, called them 'avis paradiscus,' or Paradise birds. John van Linschoten gives these names in 1598, and tells us that no one has seen these birds alive, for they live in the air, always turning towards the sun, and never lighting on the earth till they die; for they have neither feet nor wings, as, he adds, may be seen by the birds carried to India, and sometimes to Holland, but being very costly they were then rarely seen in Europe. More than a hundred years later Mr. William Funnell, who accompanied Dampier, and wrote an account of the voyage, saw specimens at Amboina, and was told that they came to Banda to eat nutmegs, which intoxicated them and made them fall down senseless, when they were killed by ants. Down to 1758, when Linnæus named the



FIG. 235. — *Paradisæa sanguinea*, red bird-of-Paradise.

largest species *Paradisæa apoda* (i. e., the footless Paradise bird), no perfect specimen had been seen in Europe, and absolutely nothing was known about them. As before mentioned, Wallace was the first naturalist to observe them in their native haunts during his eight years' travels in the Malay Archipelago from 1854 to 1862, but since his success several recent travelers have followed his steps and added considerably to the knowledge of these birds, among which may be mentioned Rosenberg, Bernstein, d'Albertis, Beccari, etc.

The great bird-of-Paradise (*P. apoda*) — see plate — is the largest species known, being generally seventeen or eighteen inches from the beak to the tip of the tail. The chief color is a rich coffee-brown, which deepens on the breast to a blackish violet or purple brown. The whole top of the head and neck is of an exceedingly

delicate straw-yellow, the feathers being short and close set, so as to resemble plush or velvet; the lower part of the throat up to the eye is clothed with scaly feathers of an emerald green color, and with a rich metallic gloss, and velvety plumes of a still deeper green extend in a band across the forehead and chin as far as the eye, which is bright yellow. The beak is pale lead-blue, and the feet, which are rather large and very strong and well formed, are of a pale ashy pink. The two middle feathers of the tail have no webs, except a very small one at the base and at the extreme tip, forming wire-like cirri, which spread out in an elegant double curve, and vary from twenty-four to thirty-four inches long. From each side of the body, beneath the wings, springs a dense tuft of long and delicate plumes, sometimes two feet in length, of the most intense golden orange color, and very glossy, but changing towards the tips into a pale brown. This tuft of plumage can be elevated and spread out at pleasure, so as almost to conceal the body of the bird. These splendid ornaments are entirely confined to the male sex, while the female is really a very plain and ordinary-looking bird of a uniform coffee-brown color which never changes; neither does she possess the long tail wires, nor a single yellow or green feather about the head. The young males of the first year exactly resemble the females.

This species is confined to the Aru Islands, a small group of islands close to New Guinea, where their loud and shrill cries, "wawk, wawk, wawk — wōk, wōk, wōk," form the most prominent and characteristic animal sound. In May, when they are in full plumage, the males assemble early in the morning to exhibit themselves, raising up their wings, stretching out their necks, and elevating their exquisite plumes, which are kept in a continual vibration. Between whiles they fly across from branch to branch in great excitement, so that the whole tree is filled with waving plumes, in every variety of attitude and motion. This habit enables the natives to obtain specimens with comparative ease. As soon as they find that the birds have fixed upon a tree on which to assemble, they build a little shelter of palm leaves in a convenient place among the branches, and the hunter ensconces himself in it before daylight, armed with his bow and a number of arrows terminating in a round knob. A boy waits at the foot of the tree, and when the birds come at sunrise, and a sufficient number have assembled, and have begun to dance, the hunter shoots with his blunt arrow so strongly as to stun the bird, which drops down, and is secured and killed by the boy without its plumage being injured by a drop of blood. The rest take no notice, and fall one after another till some of them take the alarm.

The red bird-of-Paradise (*P. sanguinea*), represented in the accompanying cut, resembles the foregoing species very much, but the side plumes are shorter, and instead of being yellow are rich crimson, and the yellow of the head pervades the back and forms a yellow band across the breast between the green and the brown; the two middle tail-feathers have the narrow webs curved upon themselves like a split quill. This species, which is confined to the Waigiu Islands at the western extremity of New Guinea, is not shot with arrows, but snared in a very ingenious manner.

The king bird-of-Paradise (*Cicinnurus regius*) is the lower figure on the plate. It is quite small, about six inches and a half long. It is of a rich glossy crimson, with a broad band of metallic green across the breast, dividing the red of the throat from the silky white of the rest of the under surface. From each side springs a fan-shaped tuft of ashy feathers tipped with green, which can be raised and spread out, as in the drawing, and the middle tail-feathers are modified into very slender wire-like shafts, nearly as long as the bird itself, each of which bears at the extremity, on

the inner side only, a web of an emerald green color, which is coiled up into a perfect spiral disc. It is a native of New Guinea and the outlying islets surrounding it, frequenting the smaller trees in the thickest parts of the forest, feeding on various fruits, often of a very large size for so small a bird. It is very active on its wing and feet, and makes a whirring sound while flying, something like the South American manakins.



FIG. 256. — *Seleucidés alba*, twelve-wired Paradise bird.

Wallace did not meet with the six-shafted Paradise bird (*Parotia scifilata*), which is confined to the main island of New Guinea. It is the middle figure of the plate, from which is at once apparent the feature which has given it its name. The plumage appears at first sight black, but it glows in certain lights with bronze and deep purple. The throat and breast are scaled with broad, flat feathers of an intense golden hue, changing to green and blue tints in certain lights. On the back of the head is a broad

recurved band of feathers, whose brilliancy is indescribable, resembling the sheen of emerald and topaz, rather than any organic substance. Over the forehead is a large patch of pure white feathers, which shine like satin; and from the sides of the head spring the six wonderful feathers. The Italian traveler, Count d'Albertis, was the first naturalist who ever shot a bird of this kind. Let me quote his description of how the bird acted the first time it was seen by an appreciating eye: "After standing still for some moments in the middle of the little glade, the beautiful bird peered about to see if all was safe, and then he began to move the long feathers of his head, and to raise and lower a small tuft of white feathers above his beak, which shone in the rays of the sun like burnished silver; he also raised and lowered the crest of stiff feathers, almost like scales, and glittering like bits of bright metal, with which his neck was adorned. He spread and contracted the long feathers on his sides, in a way that made him appear now larger and again smaller than his real size, and jumping first on one side and then on the other, he placed himself proudly in an attitude of combat, as though he imagined himself fighting with an invisible foe. All this time he was uttering a curious note, as though calling on some one to admire his beauty, or perhaps challenging an enemy. The deep silence of the forest was stirred by the echoes of his voice."

It is hard to say which one of the Paradise birds is the most beautiful or the most curious, and want of space will only allow us to mention the names of Wallace's standard-wing (*Semioptera wallacii*), with two curious long feathers standing erect on each wing; Schlegel's Paradise bird (*Schlegelia wilsoni*), with a cobalt-blue bald head, ornamented with a cross of velvety black feathers; the superb bird-of-Paradise (*Lophorina superba*), with the bifurcated breast-shield, and the still more extraordinary and enormous furcated feather-shield that rises from the lined neck; the magnificent bird-of-Paradise (*Diphyllodes magnifica*), with a similar but rounded and straw-yellow nape, crest, and a pair of elegantly curved and long filamentous tail-feathers; and finally the metallic black manucodes, remarkable for the subcutaneous convolutions of the trachea, which may even occur in the females.

In the Epimachinae, long-billed, or sickle-billed birds-of-Paradise, the peculiarities of which are indicated by the name, we find birds not less remarkable in form, and not less glorious and beautiful in colors. We shall only mention the long-tailed *Epimachus speciosus*, with the enormous long tail, and a lateral fan similar to that of the king bird-of-Paradise, and the Australian species of *Ptilorhis*, with a plumage unsurpassed in its velvety softness and the richness of the deep purple of its color. The most beautiful of this group, however, is, probably, the black, yellow, and white, twelve-wired bird-of-Paradise (*Seleucides alba*), figured in the accompanying cut, and long known to the naturalists in museums, though first met with in the free state by Wallace's assistant, Allen, and d'Albertis, whom we quote: "The *Seleucides* may pride itself on account of its plumage, and the singular shape of twelve of its feathers, six of which, on each side of the breast, diminish into twelve very thin black threads, terminating in a white point. The softness of the feathers of the back makes it very delicate to the touch, like black velvet; and in a strong light the color of the shield-like feathers on the breast changes from green to bronze and a splendid purple. The bird is so gorgeous that it is perhaps not surpassed by any other of the feathered tribes. The long feathers which cover the lower part of its body are of a very delicate yellow color, which, shaded off into white, are of a deeper color on the sides. *Seleucides* is chiefly frugivorous, although, as an exception, it may sometimes add a little meat to its customary diet."

Mr. Forbes has recently described some peculiarities of its structure, especially that of the trachea, from a specimen which died in the Zoological Gardens at London, but want of space prevents us from further remarks.

At first thought, the step from the glory we have described above to the family that has taken its name from the crow — the CORVIDÆ — seems rather sudden. But a little closer inspection of the structure of these birds, and a little knowledge of the



FIG. 257. — *Nucifraga caryocatactes*, spotted nut-cracker; *Perisoreus infaustus*, Siberian jay.

more brilliantly colored of the so-called crows will soon convince us that the birds-of-Paradise and the sagacious but scavenger-duty-performing ravens and crows are not so very distantly related.

This family is cosmopolitan, though not occurring in New Zealand, and rather sparingly represented in the Australian region. If the western and the eastern hemispheres of the globe be compared, it will be found that nearly two thirds of the species belong to the latter. It is an important fact that no member of the restricted

group which contains the typical crows and their nearest allies is found in South America. In fact the Corvidæ occurring south of Panama may all be regarded as rather recent modifications of immigrants from the Nearctic region. This family is not nearly related to any forms that are peculiar to South America.

It has been customary to divide the birds composing this family into jays and crows, assigning to each of these divisions the rank of a sub-family, while others have given similar dignity to the nut-crackers and the choughs. The differences seem hardly important enough to justify such proceedings, although popularly this multitude of species — nearly one hundred and eighty — may be grouped as above, with the addition of a section for the magpies.



FIG. 253. — *Garrulus glandarius*, European common jay.

Some of the more generalized forms resemble tits in their aspect, structure, and habits to such an extent as to make it quite probable that they are intimately related. We refer particularly to a group of jays, of which our Canada jay or 'whiskey-jack' (*Perisoreus canadensis*) is typical. A nearly allied form, but more suffused with rufous, and with the tail distinctly of the latter color, is represented in the accompanying cut, lower figure, viz., the Siberian jay (*P. infustus*), which is a common bird in all the deep pine forests of the northern Palearctic region. Like its American cousins, this tit-jay is extremely tame, noisy, and even obtrusive in its habits, at least during three fourths of the year, while towards the breeding season they suddenly become silent, preparing the nest in the most secluded parts of their native forests, and exercising all their cunning to keep it concealed.

The true and typical jays belong to the genus *Garrulus*, which is confined to the Palearctic region, being one of its most characteristic inhabitants. Most of the species are moulded upon the European species (*Garrulus glandarius*), figured in our cut, and several of them are but slight modifications of this well-known and beautiful bird. Its general color is a delicate vinaceous gray; on the head it has an erectile black-spotted crest, and the rump is pure white; but its chief ornaments are the wing-



FIG. 259. — *Cyanocitta diademata*, Mexican long-crested jay.

coverts, which are black, exquisitely barred with white and azure-blue. The drawing shows this professional nest-robber in the act of killing an unfortunate nestling. Like the other members of the family the jays are omnivorous, but they are especially fond of eggs and young birds, and may be regarded as eminently injurious, though in spring they consume a number of insects to atone for their sins of stealing fruit and berries in the autumn.

Our familiar blue-jays (*Cyanocitta*) are quite nearly related to the above, and

are so well known that we only refer to the figure, which represents the Mexican representative of our long-crested jay. The blue-colored jays are especially characteristic of the New World, and lead us directly to the glorious Central and South American *Xanthoura* jays, varied with deep black, cobalt, azure, white, yellow, and green.

The magpies may be said to differ from the jays in having much larger and more graduated tails, the central pair of rectrices being usually lengthened considerably beyond the rest. We may regard the so-called blue magpies (*Cyanopoliis*) as leading from the jays, though the chief interest of these birds lays in their geographical distribution. Like most of the true magpies their home is the Old World. But while the other forms have their centre of distribution in the Himalayas and the countries to the southeast, the two species of *Cyanopoliis* are restricted, one, *C. cooki*, to the peninsula of Spain, while the other, *C. cyaneus*, is only found in Eastern Asia, including Japan; thus these two species, which are so closely alike that it takes an expert ornithologist to distinguish between them, are separated by about five thousand miles of continuous land, a most unique case of discontinuous geographical distribution. We said that most of the magpies are Old World birds, for the reason only that representatives of the genus *Pica* enter the North American fauna. The reservation was not made to include the long-crested and long-tailed Central American genus *Calocitta*, which may be regarded as an extreme development of the blue-jays. We even doubt the propriety of removing the Oriental genus *Uroeiissa*, created for the reception of the bird figured in the accompanying cut, the red-billed blue magpie (*U. erythrorhynchus*) and allies from the jays. The species in question is ashy cobalt blue above, whitish beneath; head, neck, and breast, black with white markings above; tail and wings blue, marked with white; bill coral-red, and feet orange. In spite of its long tail, it is said to be quite terrestrial in its habits, and to feed almost entirely on the ground. It is credited with a curious antipathy towards the leopard; several of these birds, when discovering it, will follow it for more than a mile, perching on the trees and bushes above it, and keeping up a continual screeching.

But we have to return to the cut which we referred to when speaking of the Siberian jay, as the upper figure represents the spotted nut-cracker (*Nucifraga caryocatactes*), a near relative of our North American *Picicorvus columbianus*. The former has a most interesting history on account of the mystery which, until a short time ago, surrounded its breeding habits, for although resident in many places in the very heart of Europe, it is scarcely more than twenty years ago that the first authenticated eggs of this bird were procured and described, and the search for the nut-cracker's eggs is nearly a parallel to that of Wolley's search for the wax-wing's eggs. The reason why this bird for so long a time eluded the efforts of the oologists was the fact that it breeds very early, often before the snow melts away, and the total change of the bird during the breeding season, it being then silent and shy, though at other times noisy and daring. Its color is dark brown spotted with white.

This bird opens the series of the crows, which are characterized by comparatively short tail, long wings, a straight, conical, and strong bill, and generally uniform black plumage. This group contains the largest forms of the family; indeed, the largest passerine bird known is the rapacious and cunning raven (*Corvus corax*), in which the family reaches its highest development. The two Palearctic species, *C. cornix* and *C. corone*, the hooded-crow and the carrion-crow of Europe, have been a source of perplexity to Old World ornithologists, presenting a question similar to and nearly



as intricate as that of the red-shafted and yellow-shafted flickers of our continent. The carrion-crow is entirely black; the hooded-crow is gray, with the head, throat, wing, and tail black. The former inhabits in Europe the southern parts, while the hooded-crow is northern and eastern; but the areas of both overlap, and in those districts innumerable intermediate specimens occur. Hybridization easily accounts for these, inasmuch as the interbreeding of typical birds of both species is an established fact. But that was not the greatest difficulty which presented itself in the apparently western carrion-crow coming to light again in eastern Siberia, to the east of the hooded species. Seebohm has attempted to show that the true explanation is that the black one is originally an eastern species, which has invaded southern Europe, establishing a western colony there after having crossed the area inhabited by its gray cousin. To me the problem seems even easier; for I think it possible to separate the east Asiatic birds, at least subspecifically, from the European form.

FIG. 260. — *Urocissa erythrorhynchos*, red-billed jay.

Our last figure of birds of this family needs only a few touches of color to give a striking picture of two remarkable species. Both are uniform black, the upper figure, the chough (*Fregilus graculus*), with feet and bill vermillion red, while the Alpine species (*Pyrhocorax pyrrhocorax*) has the bill yellow. Both forms are inhabitants of mountainous districts in the southern parts of the Palearctic region, the first-mentioned even so far north as the British Islands. They differ considerably from the



FIG. 261. — *Fregilus graculus*, chough; *Pyrhocorax pyrrhocorax*, Alpine chough.

rest of the crows in several respects, their bills being much weaker, and the nostrils are placed much higher and nearer the culmen. *Inter se* they differ again, as seen in the figure, by the shape of the bill, and the chough by having booted tarsi. They stand quite isolated among the crows of the present day, and several facts point towards their being only the last survivals of a once numerous group, which before long will succumb and become finally extinct. Its fate in the British Islands is very suggestive, as will be seen by the following extracts from Mr. Seebohm's recent

volume: "The chough is another of those birds that are becoming rarer in our islands from no apparent cause. The encroachment of man, as Mr. Gray justly remarks, can scarcely be a reason for its disappearance; for the bird's haunts are practically inaccessible, and are usually places far removed from his industries. Formerly the chough bred in many inland localities in England, but now it is only known to frequent a few favored spots on the coast. Years ago the bird bred on almost all the suitable cliffs of the south coast; but at the present day most of its breeding stations are deserted.



FIG. 262. — *Heteralocha acutirostris*, hula-bird.

In Scotland it appears to have been much commoner quite recently than at the present time, and to have now completely deserted its inland haunts, being only found on the ocean cliffs. In Ireland its numbers have also decreased."

Leaving the question open for the present whether the Old World starlings (STURNIDÆ) are best placed here, or whether they had better be removed nearer to the American Icteridæ, from which they chiefly differ in having ten primaries, we at once proceed to review the most interesting forms of this family, which is entirely confined to the eastern hemisphere, but which in its distribution offers the peculiarity

of being absolutely wanting on the Australian continent, though occurring in New Zealand and in several of the Polynesian Islands. A light is thrown upon this singular circumstance by the fact that the New Zealand forms are quite peculiar, and that Madagascar also possesses peculiar sturnine genera.

One of these remarkable New Zealand starlings is the huia-bird (*Heteralocha acutirostris*), as depicted in the accompanying fine cut. It will be well at the outset to assure the reader that the two birds there figured really belong to the same



FIG. 263. — *Sturnus vulgaris*, European starling; *S. unicolor*, Sardinian starling.

species, being in fact, the one with the straight bill the male, the other the female. Characteristic of both is the wattle at the mouth angle. They occupy now a very limited space in a few densely-wooded mountain ranges, and like the many other abnormal types—that is, types diverging greatly from the more modern avian forms—they seem to be doomed to an early extinction. The huia was often in the systems associated with the foregoing family, but an anatomical examination which Garrod was enabled to make on a specimen which died in the London Zoological Gardens

showed that it is a true starling. It is easily tamed, and the following observation of Dr. Buller was made on a pair which he kept in captivity for more than a year:— “What interested me most of all was the manner in which the birds assisted each other in their search for food, because it appeared to explain the use, in the economy of nature, of the differently formed bills in the two sexes. To divert the birds, I introduced a log of decayed wood infested with the huhu grub [the larva of a large nocturnal beetle, *Prionoplus reticularis*]. They at once attacked it, carefully probing the softer parts with their bills, and then vigorously assailing them, scooping out the decayed wood till the larva or pupa was visible, when it was carefully drawn from its cell, treated in the way described above, and then swallowed. The very different development of the mandibles in the two sexes enabled them to perform



FIG. 264. — *Pastor roseus*, rose-colored pastor.

separate offices. The male always attacked the more decayed portions of the wood, chiselling out his prey after the manner of some wood-peckers, while the female probed with her long pliant bill the other cells, where the hardness of the surrounding parts resisted the chisel of her mate. Sometimes I observed the male remove the decayed portions without being able to reach the grub, when the female would at once come to his aid, and accomplish with her long slender bill what he had failed to do. I noticed, however, that the female always appropriated to her own use the morsels thus obtained.”

The straight, conical bill is also characteristic of the common European starling (*Sturnus vulgaris*), which is figured here with its near ally, the Sardinian starling (*S. unicolor*), both shining greenish black, the former spotted with whitish. In Europe it is of common, though somewhat local occurrence, but in most places where it

breeds it is a welcome harbinger of spring, doubly appreciated on account of its intelligence, which induces it to take up its abode in quarters provided for it by its human friends, whom it repays for their care by destroying millions of obnoxious insects. They readily breed in boxes nailed to the sides of dwelling-houses, and the more boxes there are the better, for the starling is an extremely gregarious bird. In this, as in many other respects, the starling strikingly resembles our blackbird, and it is only a matter of surprise to me that the early settlers of this country did not transfer the familiar name to the American bird.

The lovely pink color which pervades those parts of the pastor's plumage which are not glossy greenish black (see the cut) makes it one of the finest looking birds of the Old World. *Pastor roseus* is an inhabitant of the plains and steppes of western Asia, breeding irregularly as far west as Switzerland. During its autumnal wanderings small flocks are often detached from the large bodies and straggle about, often wide from its original home. It winters regularly in India. To the Rev. Mr. Tristram the reader is indebted for the following graphic sketch of his experience with the rosy pastor during his travels in the East:—

“From Kelat Seijar we pursued for two days a northeasterly course over the Syrian plain, and through the whole journey flock after flock of Pastors passed us, all pursuing a due west route. At one place we came suddenly, after mounting a gentle ascent, on the crater of an extinct volcano, full of water, and surrounded with basalt boulders. As we came up, one of these flights, which had alighted to drink, rose in alarm and darkened the air overhead. About a dozen fell to a random shot, and every one I picked up was in full breeding-plumage. At another place a solitary tree over a well was so covered with them that the color of the tree changed from black to green as we approached. Once we came on a patch of some acres which had recently been visited by locusts. The old locusts were gone, but the young, not more than a quarter of an inch long, made the ground literally alive. They rose at every step of our horses like sand-lice on the seashore from a seaweed left by the tide. Just after we had passed through this patch of devastating flight, I turned my head and saw a great globe in the air. It suddenly turned, expanded, and like a vast fan descended to the ground. We waited a few minutes, and saw acres covered with a moving black mass, dappled with pink. In a short time the mass became restless, and we rode back. The birds rose quietly, but not till we were close on them, and only those within dangerous distance. But not a young locust could we see. The Pastor had well earned its name of the ‘Locust-bird,’ and one batch of foes to man and his labors had been promptly and forever exterminated.”

Here is a bird well worth introducing into this country. Why did our busybodies not think of this beautiful benefactor, instead of creating the English sparrow nuisance?

Africa has a group of starlings peculiar to the dark continent, belonging to the genera *Lamprocolius*, *Lamprotornis*, *Juida*, etc., which with a common name we designate as glossy-mynas. They are generally of blackish color, with shining metallic reflections, green and blue, and several species have long and ample tails. Many of them are, therefore, superficially quite similar to our American crow-blackbirds (*Quiscalus*). There is no need, however, of referring to drawings, or museum specimens, for they are seen on every other lady's hat.

Another African genus, quite aberrant on account of its strong and hard beak, may perhaps be entitled to sub-family rank. It is composed of only two species of the

genus *Buphaga*, or ox-peckers, so called on account of their habits of frequenting the backs of the cattle in order to extract the grubs which infest the ruminants. The Swedish naturalist, Anderson, who traveled in South Africa, has the following note on the habits of the southern 'beef-eaters' (*B. africanus*), as they are sometimes called: "The arrival of these birds is announced by a sharp cry; and the next moment they may be seen in a little flock descending fearlessly on and amongst the cattle, which are at first much alarmed, and run about in wild confusion, just as they do when troubled with gadflies; but these apprehensions are soon dispelled, and exchanged for sensations of evident pleasure, as the ox-peckers run over their backs, sides, and bellies, like woodpeckers upon trees, except when an ox, by an occasional jerk or sudden



FIG. 265. — *Buphagus erythrorhynchus*, ox-pecker.

twist, appears to indicate that the claws of the bird have caused something like pain by touching some spot where the skin of the animal happens to be tender." The accompanying cut shows the northern species, *B. erythrorhynchus*, in full activity.

Finally, we will have to say a few words about the hill-myna (*Gracula javana*), figured on the plate facing page 516. The hill-mynas are strictly confined to the Oriental region, and are common in India. They are well-known birds, gregarious as most starlings, and easily tamed; like the European starling they can be taught to repeat words very distinctly. Their color is black, with purplish reflections, and their head is adorned with some curious flattened yellow wattles. The Indian species was

called *G. religiosa* by Linnaeus, but, as Jerdon informs us, probably by a mistake, as he never heard of its being held at all sacred.

Notwithstanding the enormous difference between the most extreme members of the series now to follow, as, for instance, between the thin-billed flower-pecker and the heavy-headed grosbeak, the link of intermediate forms which combine them seems so unbroken that we can entertain no doubt but what they are only different developments of the same common stock. We commence with several tropical forms which, though highly specialized in one direction to be presently spoken of, are probably, on the whole, more ancestral than those which we have placed at the end.

The forms here referred to are the so-called 'Tenuirostres,' corresponding to the group 'Cinnyrimorphæ' of others, chiefly embracing the sun-birds and the honey-eaters. They are characterized by a thin, pointed, more or less lengthened and curved bill, and the two families mentioned by having the tongue long, protractile, ending in a suetorial tube anteriorly bifid.

This apparatus, which resembles considerably the tubular tongue of the humming-birds, deserves a little attention, and it is worth while to note that not only is the tongue constructed on a similar principle in these families, so distantly related that they are justly placed in different orders, but that also externally, in shape, size, and coloration, the tubilingual tenuirostres, which are exclusively confined to the Old World, bear a great resemblance to the hummers. We have here an illustration of the fact "that similar functional requirements frequently lead to the development of similar structures in animals which are otherwise very distinct."

The hyoid apparatus is provided with very long cornua, which are bent over the skull as in woodpeckers and humming-birds, though not reaching further forward than the frontal bones. The horny sheath of the tongue itself forms first a single tube, which then splits up into two tubes, herein differing from that of the hummers, which is 'double-barreled' to the very base; but in the true honey-suckers (*Meliphagidæ*) the splitting up of the end of the tubes is continued dichotomously, so as to form a sort of 'brush.' Several sets of muscles effect the protrusion of the tongue and the sucking action, which by Dr. Gadow is ascertained to be accomplished automatically in about the following manner: The whole tongue and larynx is first pressed upwards against the palatal roof of the mouth by the contraction of one set of muscles, thus filling the mouth wholly. By the action of other muscles the tongue is protruded. If, now, the former muscles relax, and their opponents depress the larynx and the posterior part of the tongue, a vacuum will be produced between tongue and palate, which will then be filled with the flower nectar, into which the tip of the tongue may have been inserted. The object of the terminal vibrissæ in the sun-birds, and tubular brush in the honey-suckers, seems to be to prevent air from rushing into the tube if there should not be enough nectar to fill it, inasmuch as the fluid will then enter the anterior part of the tube by capillary action, and then be sucked up.

Professor Parker has pointed out a considerable difference in the palatal structure of the two tubilingual families referred to. He has found that the sun-birds agree with the rest of the Passeres in having the præpalatine bar running on the inner side of the palatal process of the præmaxillary, while in the honey-suckers it passes on the outer side.

In regard to the geographical distribution, we may remark that the honey-eaters chiefly inhabit Oceania and Australia. They are, as Gould says, the most peculiar and striking feature in the ornithology of the latter continent, being "to the fauna what

the *Eucalypti*, *Banksiæ*, and *Melaleucæ* are to the flora. The economy of these birds is so strictly adapted to those trees that the one appears essential to the other; for what can be more plain than that the brush-like tongue is especially formed for gathering the honey from the flower-caps of the *Eucalypti*, or that their diminutive stomachs are especially formed for this kind of food, and the peculiar insects which constitute a portion of it?" A peculiarity of many species belonging to this family, the MELIPHAGIDÆ, is the presence of naked wattles at the mouth angles.

Messrs. Layard, father and son, have recently contributed some interesting notes to the biographies of several of these birds, as observed by them in the island of New Caledonia. Of *Gliciphila undulata* they say: "This fine 'honey-sucker' is not at all uncommon in the forest, frequenting in considerable numbers certain trees when in flower; when the blossoms disappear the birds disappear also, and you may seek in vain for a single specimen in the place that a short time previously rang with their clear whistle and flute-like notes. They hang or climb in every position to feed, grasping the branches, or flowers themselves, with their strong curved claws. They are very pugnacious, fighting amongst themselves, and with any other bird that attempts to share with them their sweet repast of flower-nectar and small insects." In regard to another honey-eater of the same island, *Leptomyza aubryana*, they make the very interesting remark that they found one specimen which "had the throat covered with yellow pollen; this we have also found on *Gliciphila* and *Myzomela*, and we doubt not some of the large, lofty, flowering trees are fertilized by such agency, as insects are very scarce here."

One of the largest species of the family is the peculiar and well-known parson-bird (*Prosthemadera nova-seelandiæ*), from New Zealand, metallic black, with a curious tuft of very long and filamentous white feathers, curled in upon each other, on each side of the throat. Says Dr. Buller: "The early colonists named it the 'parson-bird' in allusion to the peculiar tufts of white feathers that adorn its throat, and their fancied resemblance to the clerical bands. To those who are familiar with the bird in its native woods, this name is certainly appropriate, for when indulging in its strain of wild notes, it displays these 'bands,' and gesticulates in a manner forcibly suggestive of the declamatory style of preaching, or, as Dr. Thompson graphically expresses it, "sitting on the branch of a tree, as a *pro tempore* pulpit, he shakes his head, bending to one side and then to another, as if he remarked to this one and to that one; and once and again, with pent-up vehemence contracting his muscles and drawing himself together, his voice waxes loud in a manner to waken sleepers to their senses. Owing to its excellent powers of mimicry, and the facility of rearing it in confinement, it is a favorite cage-bird, both with the natives and the colonists. It will learn to articulate sentences of several words with clearness, and to imitate the barking of a dog to perfection."

Here also belong some curious forms confined to the Sandwich Islands, among which is the black, yellow-tufted honey-sucker (*Moho nobilis*). Mr. Titian R. Peale has given the following account of the former use of the small yellow tufts of these birds:—

"The yellow tufts of costal feathers in this beautiful bird furnished the material for the splendid and costly robes, capes, and 'leis' of the Hawaiians in former days. The bunches of feathers, called *hulu*, are still [1840] prepared and received in payment of a poll-tax to the king; they are afterwards made up principally in 'leis' or head-bands worn by the ladies, and are beautiful but costly ornaments; but

few can afford to wear them. The mantles made of these feathers were until lately considered the principal treasures of the crown; now they are not to be seen; the labor of collecting the feathers and attaching them to a network base, a labor of years, being too great. European clothing has entirely superseded the former robes of state.

"The 'Oo' is found in most of the woody districts of the island of Hawaii; it frequents the thick foliage of the loftiest trees; in voice and manners it has some resemblance to the oriole of North America (*Icterus baltimore*). The natives cap-



FIG. 266. — *Nectarinia metallica*, sun-bird.

ture it by means of bird-line, and, after plucking the yellow feathers from beneath the wings, restore it to liberty until again wanted to assist in paying the royal tax." A fine robe made of these feathers is in the National Museum in Washington.

The sun-birds, NECTARINIDÆ, on the other hand, are more African and Indian, though ranging eastward to Northern Australia. They are generally small birds of very uniform shape, and, once seen, they are not easily mistaken for any other bird, except for a humming-bird, with which the popular mind usually confounds them.

And, indeed, if it be admissible to speak of 'representative' families of the two hemispheres, the sun-birds 'represent,' in the Old World, the hummers of the New. Uniform as is their structure, their coloration is as varied and brilliant as that of any other family, but their habits are said to be so alike that the biography of one species will answer for that of the rest. To give an idea of their habits we select a few abstracts of Jerdon's account of the common Indian purple sun-bird (*Cinnyris asiatica*):—

"This bird, like the others of its tribe, has a feeble but sweet chirping note. It feeds partly on the nectar of flowers, but a good deal on insects, small cicadellæ, flies, spiders, etc. It occasionally hovers in the air before a flower whilst extracting the honey, but generally hops about and clings to the smaller twigs and flowering branches. I have occasionally seen it snap at an insect in the air. Whilst feeding it frequently



FIG. 267. — *Certhia familiaris*, common creeper.

opens and closes its wings. A pair built their nest just outside my house door at Jalna. It was commenced on a thick spider's web, by attaching to it various fragments of paper, cloth, straw, grass, and other substances, till it had secured a firm hold of the twig to which the spider's web adhered, and the nest suspended on this was then completed by adding other fragments of the same materials. The entrance was at one side, near the top, and had a slightly projecting roof or awning over it. The female laid two eggs of a greenish-gray tinge, with dusky spots."

The species figured is the metallic sun-bird (*Nectarinia metallica*) from North-eastern Africa. It is colored as follows: head, neck and mantle deep metallic green, rest of back, the rump, and a crescent bordering the green of the throat, brilliant deep purplish blue; rest of underparts gamboge yellow, but under tail-coverts nearly white. The female is plain, pale earthy brown above, pale yellowish beneath.

We may here be allowed to quote Mr. Sharpe's words with regard to a group of nine-primaried birds which we are now going to mention briefly, viz: the *DICÆIDÆ*, which, according to him and most other authors, cannot be separated far from the *Nectariniidæ*. He introduces them in the following words: "The members of this family — if we are allowed thus to designate a group of birds which cannot be defined in exact terms — are principally Indian and Australian, a few representatives being found on the west coast of Africa. Although resembling the sun-birds in habits, very few



FIG. 263. — *Tichodroma muraria*, Alpine wall-creeper.

have the slender, creeper-like bill of the latter family; and they differ also in their nesting habits, their nest being a beautiful purse-like structure of felted materials."

Several of the forms herein included are peculiar to the Sandwich Islands, and with the rest of that most interesting fauna of surviving forms will soon become extinct. On those isolated islands they have evolved several curiously specialized generic forms, with bills ranging from that of the curiously curved beak of *Hemignathus*, which has the upper mandible nearly twice as long as the lower one, to the

grosbeak-like *Loxioides bailleui*, the generic name of which indicates its external resemblance to the stout fringilline birds.

For want of a better place we may here include the true creepers, CERTHIDÆ, a small group of climbing birds, the exact relationship of which is yet quite doubtful, notwithstanding the fact that the typical species, the common creeper (*Certhia familiaris*), here figured, and its closely allied American representative (*C. americana*) are among the most familiar birds of Europe and of this country, so that they are within the grasp of every ornithologist. The only thing which we know at present with any degree of certainty is that the old notion of the creepers being nearly allied to the nuthatches is wrong, and that in some way or another they are related to the 'Cimnirimorphæ' of modern authors. The birds composing this 'family' are usually modestly colored, and red is only found in the second species figured, the Alpine



FIG. 269. — *Certhiola flaveola*, banana-quit.

wall-creeper (*Tichodroma muraria*), the remiges of which are adorned with the most glorious crimson in addition to the white round spots on the first primaries. The bird itself is delicately slate-blue above, blackish beneath, but when flying appears nearly entirely black. I think it is the most interesting and beautiful bird I have ever met in the wild state, and I remember very well the enraptured sensation when in the Tyrolean Alps I one day made the acquaintance of this charming bird. I faced a high rocky wall, rising perpendicularly to the height of nearly a hundred feet. Presently a black object fell down in zigzag lines until, nearly reaching the foot of the cliff, the bird checked its descent by spreading its lovely wings. It now commenced to ascend the rock in jerks, as the common creeper runs up the bole of a tree, but all the time opening and closing its wings to display the glorious coloration, as well shown in our figure. It looked like a large tropical butterfly, and when to-day recalling the beautiful sight I do not wonder that I entirely forgot to shoot the bird.

The ornithologist usually is cruel and ungrateful to the creatures which give him such pleasure, but once in a while his sentiment gets the better of him.

We have above said that the sun-birds 'represent' the humming-birds in the Old World, but we might just as well reverse the comparison a little, and say that the honey-creepers (CEREBIDÆ) in the New World 'represent' the sun-birds. The thin, curved bill, and the richness and character of the coloration of the typical species are equally suggestive, and the tongue is also bitid and penicillated at the end, though not tubular. The small ultramarine blue creepers with yellow wing-marks (*Careba cyanea*) and allies from Central and South America, and the banana-quits (*Gerthiola*) from the West Indies and northern parts of South America, are familiar examples. One species of the latter, viz., *C. bahamensis*, has a claim of belonging to the fauna of the United States, in as much as it occurs in Florida. It has a pure white throat, and is thereby easily distinguished, even in the cut, from the species here figured, *C. flaveola*, from Jamaica, which, as the drawing shows, has the throat gray. Mr. Gosse speaks of this interesting species as follows: "Scarcely larger than the average size of the humming-birds, this little creeper is often seen in company with them, probing the same flowers and for the same purpose, but in a very different manner. Instead of hovering in front of each blossom, a task to which its short wings would be utterly incompetent, the quit alights on the tree, and proceeds in the most business-like manner to peep into the flowers, hopping actively from twig to twig, and throwing the body into all positions, often clinging by the feet, with the back downwards, the better to reach the interior of a blossom with his curved beak and pencilled tongue. The minute insects which are always found in the interior of flowers are the objects of his search and the reward of his perseverance."

It is very doubtful, however, if the foregoing family Cerebidae really deserves that name, for it seems impossible to draw a hard and fast line between it and that of our American warblers, and probably it should therefore be merged into the MNIOTILTIDÆ in any future attempt at a natural system. The group of birds which we have reached now, is so familiar both in appearance and in habits to North American readers, that I can dispense with any further description beyond noting that they are strictly confined to the western hemisphere. But as a 'natural history of birds' would be highly defective without at least part of a life-history of one of the warblers, and as it would be beyond the power of the present writer to improve on the delightful sketches which Mr. W. Brewster has given to the ornithological public, a few abstracts of the biography of the prothonotary warbler (*Protonotaria citrea*) by the latter are here introduced: "In general activity and restlessness few birds equal the species under consideration. Not a nook or corner of his domain but is repeatedly visited during the day. Now he sings a few times from the top of some tall willow that leans out over the stream, sitting motionless among the yellowish foliage, fully aware, perhaps, of the protection afforded by its harmonizing tints. The next moment he descends to the cool shades beneath, where dark, coffee-colored water, the overflow of the pond or river, stretches back among the trees. Here he loves to hop about on floating drift-wood, wet by the lapping of pulsating wavelets, now following up some long, inclining, half-submerged log, peeping into every crevice and occasionally dragging forth from its concealment a spider or small beetle, turning alternately his bright yellow breast and olive back towards the light; now jetting his beautiful tail or quivering his wings tremulously, he darts off into some thicket in response to a call from his mate; or, flying to a neighboring tree-trunk, clings for a

moment against the mossy bole to pipe his little strain or look up the exact whereabouts of some suspected insect prize.

"This warbler usually seeks its food low down among thickets, moss-grown logs, or floating débris, and always about water. Sometimes it ascends tree-trunks for a little way, like the black-and-white creeper, winding about with the same peculiar motion. When seen among the upper branches, where it often goes to plume its feathers and sing in the warm sunshine, it almost invariably sits nearly motionless. Its flight is much like that of the water-thrush (either species), and is remarkably swift, firm, and decided. When crossing a broad stream it is slightly undulating, though always direct. Its food consists of insects, generally of such spiders and beetles as are found about water. Audubon positively asserts that he has discovered minute molluscous animals and small land-snails in their stomachs."

Again, the Mniotiltidæ seem to grade so insensibly into the TANAGRIDÆ that it will be difficult to uphold the family distinction, unless, perhaps, the two groups be defined and limited, and the line between them drawn in a manner quite different from the present practice of ornithologists. But even if a better limitation could be found, their intimate relationship is nevertheless a certainty. The tanagers are the first of the true so-called Coniostres, which are characterized by a more massive development of the bones of the face and an early ossification of its component parts during the embryonic stage. The tanagers have not reached any high degree in that line of specialization, though, as a general rule, their bills are pretty strong and conical.

The tanagers form as characteristic a feature of the Neotropical region as do the ant-birds and the humming-birds, though, like the latter, a few species go far north in order to breed, so that this tropical family also contributes some of the most interesting members of our North American fauna. But the very fact that the North American tanagers are only five species, belonging to one genus (*Piranga*), while the total number of tanagers known is not far from three hundred and fifty, shows very plainly that this family is not truly indigenous in the Nearctic. The tanagers are not numerous in the West Indies, but some of the genera are peculiar, — for instance, the beautiful *Spindalis*, of which a new species has recently been described by Mr. Ridgway from the island of Cozumel on the coast of Yucatan. The chief headquarters of the tanagers is the forest region of South America east of the Andes, and here they are found in all their rich splendor of color, hardly surpassed even by the humming-birds or parrots. But while thus highly attractive on account of their coloration, they offer none of these extraordinary ornaments consisting of marvellously formed tufts, elongation of tail or wing feathers, oddly curved beaks, etc. Nor is there anything very characteristic, novel, or wonderful in their habits, so far as we know them. Their skill as nest-builders is not extraordinary, nor are any of them particularly prominent as songsters. Their chief attraction is their gorgeous colors, which are not distributed after any special style, all possible combinations being found within the limits of this family. There is, of course, considerable diversity in the habits of the different forms, but we must refrain from going into detail beyond quoting the following note by Mr. H. W. Bates in regard to two common species, which we insert because it shows us tanagers under an aspect quite different from what we are accustomed to here in the north: "Numbers of tanagers frequented the fruit and other trees in our gardens [near Para]. The two principal kinds which attracted our attention were the *Rhamphocelus jacapa* and the *Tanagra episcopus*. The females of both are dull in

color, but the male of *Jacapa* has a beautiful velvety purple and black plumage, the beak being partly white; while the same sex in *Episcopus* is of a pale blue color, with white spots on the wings. In their habits they both resemble the common house sparrow of Europe, which does not exist in South America, its place being in some measure filled by these familiar tanagers. They are just as lively, restless, bold, and wary; their notes are very similar, chirping and inharmonious, and they seem to be almost as fond of the neighborhood of man. They do not, however, build their nests on houses."

When interpolating the weaver-birds and the American orioles, or hang-nests, here, between the tanagers and the *Fringillidæ*, as this family is generally accepted, we do not wish to be understood as considering the finches to be "two families distant" from the tanagers. The relationship between all these four families is so intimate, and they interdigitate in so many places, that it is impossible to give an entirely satisfactory arrangement at present. It seems as if the Gordian knot can only be solved by cutting the families asunder, and then re-arranging them, or by entirely disarding the present family distinction, and regarding them all as members of one family.

The weaver-birds, or *POCEIDÆ*, are quite as characteristic of the Palæotropical countries as are the tanagers of the Neotropical. They are chiefly African, however, for it is estimated that not less than four fifths of all the known species—somewhat over two hundred and fifty—inhabit the dark continent, the rest being scattered over the Oriental and Australian regions; none are found in the Palæarctic, in New Zealand, or in America. The weavers are sparrow-like or finch-like birds, usually with conical, thick, and heavy bills, but with ten visible primaries. This is their chief, not to say their only, distinction from the sparrows. There are three well-marked types within the family, the true weaver-birds, the vinda-finches, often called widow-finches, and the small so-called waxbills.

The first mentioned of these, as the name indicates, are well known for their extraordinary nest-building. They are generally strongly-built birds of a sparrow's size. The females and the males in autumnal plumage are mostly plain brownish birds with dusky streaks and spots, but towards the breeding season the males assume a new, often highly and brightly colored dress. Two typical species are figured in the accompanying cut, but too little is shown of the nest to give us an idea of some of these remarkable structures. I would like, however, to call the attention of the reader to Fig. 124, on page 264 of this volume. On the tree in the background are visible two curious roof-shaped structures, round which a number of birds are seen flying. These represent the wonderful straw roofs which the sociable weavers (*Philetarus socius*) of South Africa, build. A colony of birds unite in the construction of this roof, which is often so heavy that the strong branches of *Acacia giraffa* give way under the weight. From the under side of the roof then each pair suspends its own individual nest, which is woven of dry grass. The nests, often twenty to forty under the same roof, with the openings downwards, are placed close together and firmly connected. This structure protects the nests most effectively against injury, for not only does the rain run off the sloping roof, but any enemy who wants to get at the eggs or young ones is apt to slide down its slippery sides. Other species build beautiful pendent retort-shaped nests which they suspend from the utmost twigs of some tree overhanging a river, or from the fronds of some lofty palm, with the view of securing the offspring against danger from climbing mammals or snakes,

and some are even known to actually strip the thin twigs of their leaves in order to make the access to the nest still more difficult. The weavers are easily kept in captivity, and even in a cage they busy themselves with weaving grass, threads — in fact, anything they can get hold of — into the wire netting of the cage, while in the aviary they keep up their regular nest-weaving.

The *vidas* (*Vidua*) are like the true weavers, but the males are adorned with enormously lengthened tail-feathers in the pairing season. They are exclusively African.



FIG. 270. — *Textor dinemellii* and *alecto*, African weaver-birds.

The waxbills, on the other hand, are also distributed over the Oriental region, and Australia possesses many very beautiful species of these exquisite little grosbeaks, which have derived their popular name from the fact that the bill of many species is red, as if made of sealing wax. Mostly delicately colored and very hardy, these birds make very attractive cage birds, and some of them, for instance one of the smallest species, the vermilion red, white-dropped *Lagonosticte*, are pleasant songsters, and most of them become very tame in confinement, so as to even readily breed in a small cage.

In their nest-building, the American orioles, or hang-nests, the Icteridæ of the systems, resemble the weaver-birds, but, like the next family, they have only nine primaries, and, in addition, their bill is more pointed and elongated. In many respects they closely resemble the ten-primaried Old World starlings, and are evidently not very distantly related. The name oriole, however, must not mislead anybody to the belief that they are in any way connected with the orioles of the eastern hemisphere. The name was transferred to the hang-nest simply on account of the black and yellow



FIG. 271. — *Ostinops citreus*, Brazilian crested cacklee.

coloration of some of the best known species. The family is strictly American, ranging "from Patagonia and the Falkland Islands to the Arctic Circle, while, as usual with exclusively American families, the larger proportion of the genera and species are found in the tropical parts of South America." They are better represented, however, in our North American fauna than either the tanagers or the humming-birds, for to them belong not far from thirty separable forms, among which the different boat-tails, blackbirds, and grackles, orioles, meadow-larks, the bobolink, and the cowbirds.

In tropical South America the hang-nests reach their highest development, and here we encounter the large species of *Cassicus*, *Ostinops*, etc., all expert nest-builders, as shown in the accompanying cut. Mr. Bates, in the narrative of his travels on the river Amazon, has the following note on one of these: "Another interesting and common bird was the japim, a species of *Cassicus* (*C. icteronotus*). It is social in its habits, and builds its nest, like the English rook, on trees in the neighborhood of habitations. But the nests are quite differently constructed, being shaped like purses, two feet in length, and suspended from the slender branches all round the tree, some of them very near the ground. The entrance is on the side, near the bottom of the



FIG. 272.—*Emberiza hortulana*, ortolan; *Granaticora melanoccephala*, black-headed bunting.

nest. The bird is a great favorite with the Brazilians of Para. It is a noisy, stirring, babbling creature, passing constantly to and fro, chattering to its comrades, and is very ready at imitating other birds, especially the domestic poultry of the vicinity." Here also belongs the troupial (*Icterus icterus*), celebrated for its exquisite song, which is considered even considerably superior to the mellow whistle of our familiar Baltimore oriole (*I. galbula*).

It is very singular to find that the cowbirds (*Molothrus*) have developed the same curious parasitic habits as the Old World cuckoos, depositing, as they do, their eggs in other birds' nests, to have them incubated and the young ones reared by the industry and devotion of deceived foster-parents.

As the family FRINGILLIDÆ is now limited, it is one of the richest in species, com-

prising more than five hundred, scattered all over the globe, with the sole exception of the Australian region, a peculiar distribution, which, according to Wallace, is "hardly to be found in any other family of birds." It is a rather polymorphic group, with an enormous variation in the shape of the conical beak, from the weak and sinuated bills of the snow-flake (*Plectrophenax*) and its allies, to the enormously powerful grain-crushing mandibles of the grosbeaks, and the odd instrument of the cross-bills (*Loxia*)



FIG. 273.—*Petronia petronia*, rock-sparrow (upper right-hand figure); *Passer hispaniolensis*, Spanish sparrow (upper left); *P. montanus*, tree-sparrow (middle); *P. domesticus*, English sparrow (lower).

for opening and extracting the seeds of pines and firs from the cones. Also in coloration there is a great diversity, though most of the forms are modestly or even plainly dressed in brown and gray, varied with yellow, and spotted and streaked with dusky; though brilliantly colored species are not missing, as, for instance, our cardinal grosbeaks (*Cardinalis*), the nonpareil and some of its allies (*Passerina*), the Himalayan scarlet (*Hamatospiza sipahi*), the different Old World bulfinches, etc.

Sundevall has attempted to divide this vast multitude in two 'phalanges,' those

with a wide and broadly arched palate (Amplipalatales), and those with the narrower and scarcely arched palate (Arctipalatales). In the latter are comprised the forms which we regard as the most specialized forms, chiefly American. In this division we find all our North American sparrows, *Ammodramus*, *Zonotrichia*, *Spizella*, *Melospiza*, *Peucaea*, *Junco*, etc., etc., also the Pitylinæ, including the cardinal (*Cardinalis cardinalis*) and the rose-breasted grosbeak (*Uabia ludoviciana*) figured in the cut on the plate facing page 544. Closely allied to the foregoing American forms, which make up the bulk of the phalanx, are the Old World Emberizinae or buntings, of which two representatives are illustrated in our next cut, viz., the ortolan (*Emberiza hortulana*), the bird to whom this name by right belongs, a common European species, which during the autumnal migrations is caught in great numbers for the table, the other being the black-headed bunting (*Granativora melanocephala*), a large and handsome species, intensely yellow beneath, and confined to the Mediterranean subregion from Italy eastward, migrating to India in winter.

The Amplipalatales are mostly Old World birds and contain the typical finches. In North America, however, we have a number of species belonging to many different genera, for instance, *Carpodacus*, *Acanthis*, *Leucosticte*, etc., but no true finches occur in South America with the exception of several goldfinches (*Spinus*), a genus strictly arctogæan, but with a distribution somewhat analogous to that of the American kingfishers. Two types of this 'phalanx' are illustrated in this volume, both very familiar indeed to our readers, but in a somewhat disagreeable way, for the lower figure of the accompanying cut represents, needless to say, a bird whose phenomenal increase, after having been idiotically introduced into this country, has given rise to considerable talk, but, alas! as yet only little action; while the wild stock of our domesticated canary, yellow and olive, is figured in the plate facing page 544.

As remarked at the beginning of the Passeroideæ, we regard the true grosbeaks as the highest specialized finches, represented in Europe by the haw-finch (*Coccothraustes coccothraustes*), and in this continent by the evening grosbeak (*Hesperiphona vespertina*). Their bills are enormously thick, heavy, and so high that their upper contours almost form one continuous curve with that of the head.

LEONHARD STEJNEGER.

INDEX.

- Abrophila, 201
 Aburria, 233
 Acanthis, 547
 Acanthisitta, 465
 Accentor, 492
 Accipiter, 304
 Accipitres, 260
 Accipitrinae, 301
 Acestrura, 449
 Acrocephalus, 502
 Acromyodi, 481
 Acromyodous, 459
 Acropternis, 476
 Acryllium, 214
 Actodromas, 108
 Adjutant, 164
 Echmophorus, 67
 Egithalos, 515.
 Egithognathous, 10
 Ena, 250
 Epiornis, 47
 Epiornithes, 47
 Esalon, 313
 Epypodius, 231
 Agami, 123
 Agapornis, 362
 Agelastes, 215
 Agelastine, 215
 Aglæactis, 444
 Agnopterus, 154
 Agrobates, 502
 Aithurus, 451
 Ajaja, 161
 Alauda, 486
 Alaudidae, 485
 Albatrosses, 85
 Alca, 69, 72
 Alcedinidae, 395, 401, 403
 Alcedinoidea, 395
 Alcedo, 401, 403
 Alcidae, 69
 Alcoidea, 68
 Alcyon, 404
 Alecteropodes, 198
 Alecorides, 121
 Aletronas, 254
 Alectrurus, 470
 Alle, 69
 Alopochen, 141
 Altrices, 3
 Aluco, 324, 346
 Aluconina, 324, 346
 Amazilia, 443
 Amazons, 367
 Amblyornis, 517
 Ammodromus, 547
 Ammonanes, 486
 Ammoperdix, 200
 Ampelidae, 511
 Ampelis, 511
 Amplipalates, 547
 Anytornis, 499
 Anacretes, 470
 Anarhynchus, 101
 Anas, 148
 Anastomus, 167
 Antida, 141
 Anatinae, 145, 147
 Anatoidere, 136
 Andigena, 417
 Androglossa, 367
 Anhima, 134
 Anhimidae, 134
 Anhimoidae, 132
 Anhinga, 193
 Anhingidae, 193
 Ani, 383
 Anisodactylous, 370
 Anomalognata, 370
 Anomalopteryx, 41
 Anous, 83
 Anseranas, 138
 Anseranatidae, 138
 Anseres, 132
 Anseriformes, 65
 Anthus, 487
 Antiolopha, 472
 Antipelmous, 369
 Antropoides, 125
 Ant-birds, 476
 Ant-shrikes, 477
 Ant-thrushes, 466-477
 Ant-wrens, 477
 Anumbius, 480
 Apaloderma, 435
 Apatornis, 24
 Aplhanapteryx, 129
 Apluriza, 99
 Aptenodytes, 59
 Apteris, 3
 Apterous penguin, 49
 Apteryges, 48
 Apteryx, 49
 Aptornis, 131
 Aquila, 281
 Aquilinae, 278
 Araçari, 416
 Aramidæ, 127
 Aramus, 121, 127
 Arara, 355
 Archaeopteryx, 21
 Archibuteo, 290
 Antipalates, 547
 Ardeidae, 173
 Ardeoidere, 162
 Ardeomega, 177
 Ardetta, 174
 Arenaria, 98
 Argus, 227
 Argyria, 443
 Ariel, 418
 Artamidae, 511
 Artamus, 511
 Asio, 343
 Astur, 304
 Asturina, 290
 Asturinula, 308
 Atelornis, 330
 Athene, 327
 Atrichornis, 462
 Atrichornithidae, 462
 Attagis, 93
 Atthis, 449
 Augastes, 444
 Auks, 69, 72
 Aves, 1
 Avestruz, 38
 Avicida, 309
 Avocettinus, 445
 Avocettula, 444
 Babblers, 490
 Balaniceps, 171
 Balanicipitidae, 171
 Balearica, 125
 Bambusicola, 203
 Banana quit, 540
 Baptonis, 30
 Barbets, 418
 Barking-bird, 477
 Basilinna, 443
 Batrachostomus, 387
 Baza, 309
 Bee-eaters, 395
 Bee-martin, 469, 471
 Beef-eater, 533
 Bejator grande, 414
 Bell-birds, 475
 Bellona, 444
 Bernicles, 142
 Bhringa, 510
 Birds, 1
 Birds-of-Paradise, 470, 516, 518
 Birds of prey, 260
 Bitter-bump, 175
 Bittern, 174, 175
 Bittern, sun, 116
 Bizura, 152
 Blackbirds, 496
 Black cap, 503
 Black-cock, 210
 Black crow, 532
 Bluebirds, 494
 " fairy, 490
 Bluejay, 525
 Boat-bill, 178
 Boatswain, 76, 181
 Bob White, 206
 Bog-bumper, 175
 Bolborhynchus, 366
 Bonasa, 211
 Boobies, 188
 Booted tarsus, 9
 Botaurus, 175
 Bourcieria, 452
 Bower-birds, 516
 Brachypteracias, 390
 Brachypteracinae, 390
 Brachypteres, 56
 Brachyrhamphus, 72
 Brant, 142
 Branta, 142
 Broad-mouths, 462
 Brotogerys, 366
 Brown thrasher, 507

- Brush-birds, 462
 Brush-turkey, 232
 Bubo, 337
 Bubulcus, 178
 Bucconidae, 412
 Bulbuls, 490
 Buceros, 406
 Bucerotidae, 395, 401
 Buchanga, 510
 Bucorvus, 408
 Bucorvina, 408
 Bulbuls, 490
 Bulweria, 90
 Buntings, 546
 Buphaga, 533
 Busarellus, 290
 Bush-chat, 498
 Bustards, 113
 Butcher-birds, 511
 Butco, 292
 Buteogallus, 290
 Butcola, 290
 Buzzard, anthracite, 290
 " bee, 290
 " broadwinged, 293
 " carrion, 300
 " common, 293
 " ferrugineous, 291
 " Gruber's, 290
 " honey, 299
 " rough-legged, 291
 " Swainson's, 293
 " turkey, 267
 " white-tailed, 292
 Buzzards, 290
 Cacatua, 353
 Caccabis, 202
 Caccothraustes, 547
 Caica, 367
 Cairina, 146
 Callipepla, 206
 Callisittacus, 355
 Callocitta, 526
 Calloperdix, 203
 Callothorax, 449
 Calenas, 243
 Calenatidae, 243
 Calopezus, 54
 Calophasis, 220
 Calypste, 449
 Calyptomena, 463
 Calyptorhynchus, 354
 Campanero, 475
 Campephagidae, 509
 Campephilus, 431
 Campistolaimus, 151
 Campylopterus, 466
 Campylophynchus, 505
 Canace, 210
 Canada jay, 524
 Cape Barren goose, 138
 Cape pigeon, 90
 Capercaillie, 210
 Caprimulgidae, 387
 Caprimulginae, 387
 Caracara, 301
 Cardinalis, 546
 Cariama, 121
 Cariamoidea, 119
 Carine, 326
 Carphibis, 160
 Carpodacus, 547
 Carpodectes, 474
 Carpophaga, 258
 Carpophagidae, 254
 Carrancha, 301
 Carrion buzzards, 300
 Carrion-crow, 266
 Casmarrhynchus, 475
 Cassicus, 545
 Cassowaries, 39, 41
 Casuaridae, 41
 Casuarinus, 42
 Casuaroides, 39
 Catarractes, 63
 Cat-bird, 507
 Cathartha, 449
 Cathartes, 266
 Cathartidae, 263, 266
 Catharus, 497
 Catherpes, 505
 Catreus, 220
 Cecomorphae, 64
 Cedar-bird, 511
 Celeomorphae, 423
 Celeus, 427
 Centrocerus, 209
 Centropus, 381
 Ceophileus, 431
 Cephalolepis, 444
 Cephalopterus, 474
 Cephus, 72
 Cere, 260
 Cereopsidae, 137
 Cereopsis, 137
 Ceriornis, 223, 224
 Cerorhina, 73
 Certhia, 539
 Certhiidae, 539
 Certhilauda, 486
 Certhiola, 540
 Ceryle, 404
 Cettia, 501
 Ceyx, 404
 Chaenomorphae, 132
 Chaetocercus, 449
 Chaetopus, 204
 Chaetura, 439
 Chaeturinae, 437
 Chaha, 134
 Chalceopelia, 246
 Chalcophaps, 245
 Chalybura, 454
 Chamaea, 504, 506
 Chamaeidae, 506
 Chamaepetes, 233
 Chamaepelia, 247
 Channel-bill, 378
 Chapparal-cock, 382
 Charadriidae, 98
 Charadriinae, 99
 Charadriomorphae, 95
 Charadrius, 96
 Chat, bush, 498
 " stone, 498
 " tyrant, 468
 " whin, 498
 Chauna, 134
 Cheer, 221
 Chelidon, 509
 Chenalopex, 141
 Chenopsis, 143
 Chimachima, 302
 Chimango, 302
 Chimney swallow, 439
 Chionidae, 92
 Chionis, 93
 Chionoides, 92
 Chiroxiphia, 472
 Chizarethis, 372
 Chlamydochen, 142
 Chlamydochora, 517
 Chloephaga, 142
 Chloropsis, 490
 Chlorostilbon, 442
 Cholornis, 514
 Chough, 528
 Chrysolampis, 444
 Chrysotis, 567
 Chunga, 121
 Churea, 381
 Churunche, 471
 Ciconia, 168
 Ciconiidae, 162
 Ciconiiformes, 65
 Cincinnurus, 529
 Cinclidae, 505
 Cinclus, 505
 Cinnyrimorphae, 534
 Cinnyris, 537
 Circaetus, 285
 Circinae, 294
 Circus, 294
 Cisticola, 499
 Civetta, 327
 Cladorhynchus, 107
 Clamator, 203
 Clamatores, 459
 Clangula, 148
 Clivicola, 509
 Clytolaema, 454
 Cnemidornis, 136
 Cnemidornithidae, 136
 Coccytes, 377
 Coccyzura, 249
 Cochlearius, 178
 Cockatoos, 352
 Cock-of-the-plains, 209
 Cock-of-the-rock, 473
 Coccyba, 540
 Coccybidae, 540
 Colaptes, 427
 Coleoramphi, 92
 Colioidae, 393
 Colius, 393
 Collocalia, 437
 Columba, 252
 Columbae, 237, 242
 Columbula, 247
 Coly, 394
 Colymbidae, 66
 Colymboides, 66
 Colymbus, 67
 Condor, 269
 Conirostres, 484, 541
 Conopophaga, 476
 Conopophagidae, 476
 Conuridae, 364
 Conurus, 365
 Coots, 131
 Coppersmith, 420
 Coquettes, 449
 Coracias, 390
 Coraciidae, 389
 Coracioides, 384
 Coracopsis, 363
 Cormorants, 400
 Corvidae, 523
 Corvus, 483, 526
 Coryllis, 359
 Coryphilus, 359
 Corythocola, 372
 Corythopsis, 476
 Coscoroba, 147
 Cosmetornis, 389
 Cotinga, 474
 Cotingidae, 473
 Coturnix, 198
 Coucal, 381
 Courlans, 127
 Courser, 101
 Coverts, 4
 Cow-bird, 545
 Cracidae, 232
 Cracinae, 233
 Cracticus, 511
 Cranes, 121, 123, 125
 Crax, 233, 234
 Creepers, 539

- Crested grebe, 67
 Criniger, 490
 Crocodile bird, 100
 Crocopus, 255
 Cross-bills, 546
 Crossoptilon, 226
 Crotophaga, 374, 383
 Crow, carrion, 266, 526
 " fish, 192
 " hooded, 526
 " king, 510
 " white, 278
 Crow-blackbird, 532
 Crows, 523
 Cryptornis, 404
 Crypturi, 51
 Cuckoo, chameleon-bill, 378
 " drongo, 389
 " European, 376
 " golden, 378
 " great spotted, 377
 " ground, 381
 " horn-bill, 378
 " lark-heeled, 381
 " Malaccan, 374
 " yellow-billed, 379
 Cuckoos, 373
 Cuculidae, 373
 Cuculinae, 374
 Cuculoides, 371
 Cuculus, 374
 Culcirostris, 484
 Cupidonia, 209
 Curassows, 233
 Curlew, red-billed, 106
 " stone, 112
 Curlews, 105
 Cursores, 56, 113
 Cursorius, 101
 Curvirostris, 484
 Cyanecula, 497
 Cyanocitta, 525
 Cyanolanius, 512
 Cyanopoliis, 526
 Cyanophaia, 442
 Cyanorhamphus, 356
 Cyanotis, 470
 Cyclopsittacus, 358
 Cyclophorus, 73
 Cyclophorus, 513
 Cygnopsis, 142
 Cygnus, 143
 Cymbirhynchus, 463
 Cymindis, 299
 Cynanthus, 447
 Cypseliformes, 370, 435
 Cypselomorphæ, 435
 Cypselus, 439
 Cyrtonyx, 206

 Dab-chick, 67, 68
 Dafila, 148
 Damophila, 443
 Dansador, 473
 Daption, 50
 Darters, 193
 Dasypades, 2
 Demoiselle, 125
 Dendragapus, 210
 Dendrochelidon, 437
 Dendrocolaptes, 478
 Dendrocolapidae, 478
 Dendrocygna, 146
 Dendrocygna, 143
 Dendrocygna, 205
 Dendrocygna, 484
 Dermorhynchus, 136
 Derotypus, 367
 Desmognathus, 10
 Desmopelmous, 368

 Diatryma, 33, 55
 Dichromatism, 6
 Dicæidae, 538
 Dicæuridae, 509
 Dicranostreptus, 510
 Didida, 238
 Didrie, 378
 Didunculidae, 240
 Didunculus, 240
 Didus, 238
 Dinornis, 43
 Dinornithoides, 43
 Diomedea, 86
 Diomedidae, 85
 Diphlogena, 452
 Diphyllodes, 522
 Dippers, 505
 Discura, 448
 Dissemurus, 510
 Dissoura, 169
 Divers, 69
 " masked, 73
 Docimastes, 452
 Dodaers, 239
 Dodo, 238
 Domicella, 358
 Dotterel, 96, 107
 Dove, Carolina, 250
 " ground, 247
 " partridge, 246
 " ring, 253
 " scaly, 247
 " sea, 69
 " turtle, 248
 Doves, 237
 Drepanoptilus, 256
 Dromæognathæ, 31
 Dromæognathus, 10
 Dromæopappi, 27
 Dromadidae, 97
 Dromaiidae, 40
 Dromaius, 40
 Dromas, 97
 Drongo-shrikes, 509
 Dronte, 238
 Dryobates, 428
 Dryocopus, 429
 Ducula, 258
 Duck, coscoroba, 147
 " eider, 149
 " Labrador, 151
 " loggerhead, 149
 " mandarin, 148
 " merganser, 153
 " Muscovy, 146
 " musk, 152
 " race-horse, 149
 " rosy-billed, 146
 " ruddy, 152
 " sea, 145
 " side-wheel, 149
 " steamer, 149
 " surf, 148
 " torrent, 153
 " tree, 145
 Ducks, 136, 145
 Dysporomorphæ, 181

 Eagle, bald-headed, 284
 " black, 285
 " Bonelli's, 284
 " caracara, 301
 " crowned, 285
 " dwarf, 283
 " fishing, 284
 " golden, 282
 " Guiana, 287
 " harpy, 287
 " hawk, 284
 " imperial, 283

 Eagle, king, 283
 " Malay, 285
 " sea, 284
 " serpent, 285
 " short-toed, 285
 Eagle-vulture, 279
 Eagles, 278, 281
 Eclectus, 362
 Ectopistes, 251
 Edible bird's-nests, 438
 Egrets, 178
 Eiders, 149
 Elanoides, 297
 Elanus, 297
 Elornis, 154
 El Turco, 477
 Elvira, 443
 Emberiza, 547
 Emberizinae, 547
 Emeu, 41
 Empidonax, 471
 Emus, 39, 40
 Enalornis, 30
 Endaspidian, 464
 Enicuridae, 489
 Enicurus, 489
 Enneocotus, 512
 Ephippiorhynchus, 167
 Epimachinae, 522
 Epimachus, 522
 Eremomelinae, 491
 Eretmopodes, 65
 Eriocnemis, 443
 Erimatura, 132
 Erimaturinae, 151
 Erithacus, 496
 Erythropus, 315
 Erythosterna, 492
 Esacus, 113
 Eucephala, 443
 Eudromias, 96
 Eudynamys, 375
 Eudytes, 63
 Eudytula, 60
 Eugenies, 454
 Eugenia, 454
 Eulabeia, 142
 Eulampis, 455
 Eumomota, 397
 Eumithes, 64
 Eupetes, 490
 Eupetomana, 456
 Euphema, 356
 Euplocamus, 216
 Eupodotes, 113
 Eupsortyx, 206
 Eurhipidura, 31
 Eurylaimidae, 462
 Eurylaimoides, 460, 462
 Euryrhorhynchus, 107
 Eurypyga, 116
 Eurypygidæ, 116
 Eurypygididae, 115
 Eurystomus, 380, 391
 Eustiphanus, 452
 Eutoxeres, 457
 Eutrygon, 242
 Euxemura, 169
 Exaspidean, 464
 Excalfactoria, 199

 Falcipectus, 210
 Falco, 306, 309
 Falcon, Bengal, 309
 " chanting, 308
 " crested, 309
 " Eleanor, 315
 " femoral, 315
 " finch, 309
 " great northern, 311

- Falcon, Greenland, 311
 " hobby, 314
 " Icelandic, 311
 " kite, 309
 " lanner, 313
 " lugger, 313
 " notched, 309
 " peregrine, 309
 " plumbeous, 315
 " prairie, 313
 " singing, 308
 Falconidae, 263, 275
 Falconina, 308
 Falconry, 316
 Falcons, 308
 Fan-tails, 492, 499
 Feathers, 2
 " arrangement of, 3
 " color of, 5
 Ficedula, 492
 Finches, 547
 Fin-foots, 68
 Fire-backs, 216
 Fire-crest, 504
 Fire-tail, 446
 Fish-crow, 192
 Fish-hawk, 192, 203
 Flamingoes, 153, 154
 Flickers, 427
 Florisuga, 451
 Fly-catchers, 468, 492
 " Acadian, 471
 " paradise, 492
 " pied, 492
 " rose-breasted, 474
 " spotted, 492
 " tyrant, 471
 " vermillion, 471
 Fork-tails, 489
 Formicariidae, 477
 Formicariina, 477
 Formicarioidae, 469, 476
 Formicivorina, 477
 Francolinus, 203
 Francolinus, 203
 Fratercula, 73
 Fregatidae, 184
 Fregatoideæ, 183
 Fregatta, 184
 Frigate birds, 184
 Frigate-pelican, 184
 Fregilus, 528
 Fringillidae, 545
 Frog-mouth, 387
 Fulca, 131
 Fulmar, arctic, 90
 " giant, 88, 90
 Fulmarus, 90
 Funariidae, 479
 Funarius, 480

 Gachita, 94
 Galbula, 414
 Galbulidae, 412, 414
 Galeoscoptes, 507
 Gallina, 197, 215
 Gallinago, 110
 Gallinula, 131
 Gallinules, 131
 Gallinule, 204
 Gallus, 215
 Gannets, 188
 Gaper, 463
 Gare-fowl, 72
 Garrulus, 525
 Gastornis, 54
 Gastornithes, 54
 Gavia, 81
 Gecinulus, 428
 Geese, bernicle, 142
 Geese black-backed, 146
 " land, 142
 " sea, 142
 Gefir, 72
 Gentleman, 188
 Geobasites, 300
 Geococcyx, 381
 Geocolaptes, 428
 Geopelia, 250
 Geophaps, 244
 Geopsittacus, 351
 Geositta, 479, 481
 Geotrygon, 246
 Geranomorphæ, 122
 Giant heron, 177
 Glareolidae, 95
 Glareolus, 95
 Glaucidium, 329
 Gliciphila, 535
 Gnat-catchers, 507
 Goat-suckers, 357
 Godwits, 107
 Gold-crest, 504
 Gold-finches, 547
 Goose, barred-headed, 142
 " Cape Barren, 138
 " Egyptian, 141
 " emperor, 142
 " fox, 141
 " gray-lag, 142
 " Nile, 141
 " Orinoco, 141
 " semi-palmated, 139
 " solan, 188
 " spur-winged, 140
 " swallow, 183
 " swan, 142
 Goshawks, 304
 Goslets, 142
 Gouldia, 448
 Goura, 242
 Gourida, 242
 Gracula, 533
 Graculavus, 21, 28
 Gralla, 91
 Grallaria, 477
 Gratiatorna, 547
 Graphophasianus, 220
 Great auk, 72
 Grebes, 66
 Greenlets, 513
 Griffin, 274, 275
 Grinder, 493
 Gripphorns, 21
 Grosbeaks, 546
 Ground-thrushes, 467
 Ground-tits, 506
 Grouse, 198, 207
 " blue, 210
 " dusky, 210
 " Harlaub's, 210
 " hazel, 212
 " pine, 210
 " ruffed, 211
 " sand, 205
 " spruce, 210
 " wood, 210
 Gruidæ, 123
 Gruoidæ, 121
 Grus, 123
 Guacharo, 385
 Guara, 160
 Gubernates, 470
 Guillemots, 71
 Guinea-fowl, 213
 Guinea-hen, 214
 Guild-guild, 477
 Guira, 374, 383
 Gull, black-headed, 78
 " fork-tailed, 81
 Gull, ivory, 81
 " mackerel, 79
 " Ross's, 79
 " wedge-tailed, 79
 Gulls, 74, 77
 Guttera, 214
 Gyges, 83
 Gymnasio, 326
 Gymnopedes, 2
 Gymnopenia, 247
 Gymnophaps, 252
 Gymnorhina, 511
 Gymnorhina, 511
 Gyrfalcons, 311
 Gypætus, 280
 Gypogeranidae, 263, 264
 Gypogeranus, 263
 Gypohierax, 279
 Gyps, 275

 Habia, 547
 Habroptila, 131
 Hadrestomus, 474
 Hamatopus, 98
 Hamatospiza, 546
 Haleyon, 401, 403
 Haleyonina, 401
 Haliaetus, 281, 284
 Hang-birds, 544
 Hang-nests, 544
 Haplophona, 459
 Haplophona, 459
 Harpactes, 435
 Harpagus, 309
 Harporhynchus, 507
 Harpyhaliaetus, 287
 Harpyia, 287
 Harriers, 294
 Hav-sula, 188
 Hawk, chicken, 306
 " Cooper's, 306
 " duck, 309
 " fish, 192, 203
 " goose, 305
 " hen, 292
 " man-of-war, 184
 " marsh, 294
 " night, 389
 " peregrine, 309
 " pigeon, 313
 " quail, 309
 " sharpshinned, 306
 " singing, 308
 " sparrow, 304, 306, 309, 315
 " squirrel, 291
 Hawks, 304
 Hematortyx, 200
 Helactin, 449
 Helianthea, 452
 Helianthus, 281
 Heliodilus, 348
 Heliodoxa, 454
 Helionis, 68
 Heliornithoides, 68
 Heliotrux, 444
 Helotarsus, 281, 287
 Hemicircus, 428
 Hemignathus, 538
 Hemistephania, 452
 Hen-harrier, 294
 Hen-hawks, 292
 Hemicophaps, 245
 Herodias, 178
 Herodii, 157
 Heron, buff-backed, 153
 " giant, 177
 " night, 178
 " variegated, 174
 Herons, 173
 Hesperiphona, 547

- Hesperornis, 21, 27
 Heteralocha, 530
 Heterodactylus, 369
 Heteromeri, 463
 Heteropelma, 472
 Heteropelmous, 369
 Hieracidea, 309
 Hierax, 309
 Hierococyx, 374
 Hierofalco, 311
 Hill-myna, 533
 Hill-tits, 491
 Himantopus, 107
 Hippalelectro, 41
 Hirundinidae, 507
 Hirundo, 509
 Hoatzin, 197
 Hobby, 314
 Holaspidean, 464
 Holorhinal, 11
 Homomeri, 463
 Homrai, 407
 Honey-bird, 422
 Honey-creepers, 540
 Honey-eaters, 534
 Honey-guides, 421
 Honey-suckers, 535
 Hoopoes, 410
 Hoplopterus, 100
 Hornbills, 404
 Houbara, 113
 Huia-bird, 530
 Hummer, Chimborazo, 455
 " horned, 450
 " ruby and topaz, 441
 " ruby throat, 450
 " sickle-billed, 456
 " sword-billed, 453
 " topaz, 451
 Hummers, 441
 Hummers, green, 442
 Humming-birds, 441
 Hydrallector, 104
 Hydrocoleus, 78
 Hydrophasianus, 104
 Hylaetes, 477
 Hylocharis, 443
 Hylomanes, 397
 Hyporachis, 3
 Hypositta, 515
 Hypotriorchis, 314

 Iache, 443
 Ianthanas, 252
 Ibididae, 158
 Ibis, 158
 " glossy, 160
 " sacred, 78, 158, 163
 " scarlet, 160
 " straw-throated, 160
 " wood, 162
 Ibycter, 304
 Iceland, 311
 Ichthyornis, 21
 Icteridae, 544
 Icterus, 545
 Ictinia, 297
 Impennes, 56
 Indicator, 421
 Inertes, 49
 Indicatoridae, 412, 421
 Invisible bird, 491
 Iolama, 454
 Ionornis, 131
 Irena, 490
 Ironsmith, 420
 Irrisor, 412

 Irrisoridae, 412
 Island hen, 131
 Ithaginis, 216

 Jabiru, 167
 Jacamaralcyon, 414
 Jacamars, 414
 Jacamerops, 414
 Jacana, 104
 Jacanidae, 103
 Jackass-penguin, 59
 Jagers, 75
 Jan van Gent, 188
 Jays, 524
 Joao doido, 414
 Juida, 532
 Juliamya, 443
 Junco, 547
 Jungle-fowl, 215
 Jyngina, 433
 Jynx, 433

 Kagu, 117
 Kalij, 216
 Kaka, 353
 Kakapo, 350
 Kenopia, 490
 Kestrel, 315
 Ketupa, 337
 King-awk, 69
 King bird, 469, 471
 King-crow, 510
 Kingfishers, 401
 Kinghunter, giant, 401
 Kinglets, 504
 King-penguin, 59
 Kirumbo, 392
 Kite, Arabian, 297
 " bee, 299
 " black, 297
 " black-shouldered, 297
 " black-winged, 297
 " Brahminy, 295
 " common, 296
 " everglade, 298
 " fork-tailed, 297
 " honey, 299
 " hook-billed, 298
 " Mississippi, 297
 " pariah, 297
 " red, 296
 " red-backed, 295
 " swallow-tailed, 297
 " white-tailed, 297
 Kite-falcon, 309
 Kites, 295
 Kittiwakes, 81
 Kiwi, 48
 Knot, 107

 Lagonosticte, 543
 Lagopus, 207
 Lamellirostres, 56, 132, 136
 Lamelloso-dentali, 136
 Laminipiantares, 481
 Lämmergeyer, 280
 Lampornis, 455
 Lampraster, 454
 Lamprococyx, 378
 Lamprocolius, 532
 Lamprotornis, 168, 532
 Laniarius, 512
 Laniida, 511
 Lanius, 512
 Lanner, 313
 Laornis, 30
 Laopteryx, 23
 Lapwing, 59
 Larida, 77
 Larks, 185, 186

 Laroidea, 74
 Larus, 78
 Latirostres, 484
 Laughing jackass, 402
 Laurellardia, 410
 Leech-eater, 100
 Leguaria, 129
 Leiotrichidae, 421
 Leipoa, 231
 Lepidogrammus, 381
 Leptomyza, 535
 Leptoptila, 246
 Leptoptilos, 164
 Leptosomatidae, 392
 Leptosomus, 392
 Lerwa, 202
 Lesbia, 447
 Lestornis, 30
 Leucopternis, 290
 Leucosarcia, 245
 Leucosticte, 547
 Licmetis, 353
 Licornis, 132
 Limicola, 65, 95
 Limnaetus, 285
 Limnatornis, 410
 Limpkin, 121, 127
 Lipaugus, 474
 Lipoglossa, 404
 Lobophasis, 216, 218
 Lobipedes, 122
 Loddigesia, 447
 Locust-bird, 532
 Locustella, 502
 Log-cock, 431
 Lomvias, 71
 Longipennes, 56, 65, 75.
 Loons, 69
 Lophocactus, 285
 Lophodytes, 153
 Lopholaimus, 258
 Lophophaps, 244
 Lophophorninae, 223
 Lophophorus, 223, 225
 Lophosittacus, 352
 Lophorina, 522
 Lophornis, 449
 Lophortyx, 206
 Lophotriorchis, 285
 Lory, 358, 362
 Love-birds, 362
 Loxia, 546
 Loxioidens, 539
 Lagger, 313
 Landa, 73
 Lascina, 496
 L'Ynambu, 52
 Lypornix, 413
 Lyre-birds, 461

 Macaws, 365
 Machaeropterus, 472
 Macrochires, 435
 Macroclactyl, 122
 Macrodipteryx, 389
 Macronus, 490
 Macronyx, 488
 Macropsalis, 389
 Macropteres, 56
 Macropygia, 249
 Macromis, 33, 40
 Magaropercidix, 200
 Magpies, 526
 Maguari, 169
 Malacotinae, 512
 Malacorhynchus, 148
 Mallard, 148
 Malurina, 499
 Manacus, 472
 Manakins, 172

- Mandarin duck, 148
 Man-of-war hawk, 184
 Mann-na, 257
 Ma-quail, 373
 Marabou, 164
 Martin, European, 509
 " purple, 509
 " bee, 469, 471
 Martineta, 54
 Mascarinus, 360
 Masius, 472
 Masked divers, 73
 Meewah, 104
 Megacephalon, 231
 Megalaima, 420
 Megalaimidae, 412, 418
 Megalestris, 75
 Megalophonus, 486
 Megalornis, 33, 40
 Megapodes, 229
 Megapodidae, 229
 Megapodinae, 229
 Megapodius, 230
 Meiornis, 44
 Melampitta, 466
 Melanerpes, 431
 Melanocorypha, 486
 Melanoperdix, 200
 Melagrada, 222
 Meleagrinae, 222
 Melagris, 222
 Melierax, 308
 Meliphagidae, 535
 Mellisuga, 450
 Melodes, 497
 Melopeia, 247
 Melopitta, 466
 Melospiza, 517
 Melopsittacus, 355
 Menura, 461
 Menuridae, 461
 Menuroidea, 460
 Merganetta, 153
 Mergansers, 152
 Merlin, 313
 Meropidae, 395
 Meropinae, 397
 Merops, 396
 Merula, 496
 Mesites, 115, 119
 Mesitidae, 119
 Mesomyodi, 459
 Mesomyodous, 459
 Metallura, 444
 Metopiana, 146
 Metopidina, 104
 Metriopelia, 247
 Micrastur, 308
 Micrathene, 328
 Microcichla, 489
 Microglossus, 354
 Microperdix, 199
 Micropodidae, 437
 Micropodinae, 437, 439
 Micropodoideae, 435
 Micropsittacidae, 357
 Micropus, 439
 Middle coverts, 4
 Migration, 16
 Milvago, 502
 Milvulus, 470
 Milvus, 296
 Mimidae, 507
 Minus, 507
 Minivet, 509
 Mire-drum, 175
 Mitua, 233
 Mniotiltidae, 510
 Moa, 43
 Mocking-birds, 507
 Modest-bird, 257
 Moho, 131, 535
 Molothrus, 515
 Molting, 4
 Momotidae, 395, 397
 Momotus, 398
 Monals, 225
 Monasa, 413
 Moor hen, 131
 Morphnus, 287
 Motacilla, 488
 Motacillidae, 487
 Mother Carey's chickens, 89
 Motmot, 397
 Mountain whistler, 494
 Mountain witch, 246
 Muis-vogel, 394
 Murres, 71
 Muscicapa, 492
 Muscicapidae, 492
 Muscles, 14
 Muscivora, 469
 Museovy duck, 146
 Muscular formula, 11
 Musophagidae, 371
 Musophagus, 372
 Myadestes, 494
 Mycateria, 167
 Myristicivora, 258
 Myzomela, 535
 Nandu, 37
 Nanodes, 355
 Nasica, 478
 Nasiterna, 358
 Natatores, 56
 Nauclerus, 297
 Nectarinia, 537
 Nectarinidae, 536
 Neophron, 277
 Neopus, 285
 Nesocoleus, 427
 Nesocichla, 494
 Nestor, 352
 Nettepus, 142
 Night-hawk, 389
 Nightingales, 496
 " Ceylon, 491
 Night-jar, 389
 Ninox, 332
 Nisactus, 281, 284
 Noddies, 83
 Nomophthalmus, 368
 Nothocrax, 233, 234
 Notornis, 131
 Nothura, 51
 Nucifraga, 526
 Numenius, 106
 Numenius, 106
 Numidinae, 213
 Nut-crackers, 526
 Nuthatches, 515
 Nyctale, 341
 Nyctia, 335
 Nyctibiinae, 387
 Nyctibius, 387
 Nycticorax, 178
 Nyctornis, 397
 Oceanitinae, 85
 Oceanites, 88
 Oceanitidae, 85, 88
 Oceanodroma, 88
 Ochreata, 464
 Ocydromus, 128
 Ocyphaps, 246
 Odontoholcor, 24, 27
 Odontophorinae, 205
 Odontophorus, 205
 Odontornis, 23
 Odontornithes, 23
 Oedienemidae, 112
 Oedienemus, 112
 Oidemia, 146
 Oil-bird, 385
 Oil-gland, 9
 Old squaw, 148
 Oligomyodi, 459
 Olor, 145
 Onychotes, 290
 Oo, 536
 Open-bill, 166
 Ophrysia, 199
 Opisthocomi, 196
 Opisthocornis, 196
 Oreonympha, 445
 Oreortyx, 206
 Oreoperdix, 201
 Oreophasinae, 232
 Oreophasis, 232
 Oreotrochilus, 455
 Oriole, Baltimore, 545
 " American, 544
 Orioles, true, 515
 Orioliidae, 515
 Oriolus, 515
 Ornithopappi, 21
 Ortalis, 233
 Orthonyx, 490
 Ortolan, 547
 Ortygornis, 204
 Ortyx, 206
 Oscines, 481
 Ostrich, African, 33
 " South American, 37
 Osprey, 233
 Ossifraga, 88, 90
 Ostinops, 545
 Otidiidae, 56, 113
 Otidiphaps, 242
 Otis, 113
 Otocoris, 486
 Otogyps, 277
 Otus, 343
 Ouzel, ring, 496
 " water, 496
 Oven-birds, 480
 Owl, Acadian, 344
 " barn, 346
 " barred, 345
 " brown, 345
 " burrowing, 324
 " eagle, 337
 " flammulated, 342
 " gnome, 330
 " great grey, 345
 " hairy-footed, 332
 " hawk, 334
 " horned, 337
 " laughing, 333
 " little, 327
 " long-eared, 343
 " mottled, 342
 " pigmy, 329
 " powerful, 333
 " Richardson's, 344
 " saw-whet, 344
 " screech, 342, 346
 " scops, 341, 342
 " short-eared, 343
 " snowy, 335
 " sparrow, 330
 " spotted, 328
 " tawny, 345
 " Tengmalm's, 344
 " white-faced, 333
 " Whitney's, 328
 Owl-parrots, 350
 Owls, 321
 Ox-peckers, 533

- Oxyrhynchidae, 469
 Oxyrhynchus, 469
 Oyster-catchers, 98

 Pachyrhamphus, 474
 Palæodyptes, 63
 Palæocygnus, 143
 Palæolodontidae, 154
 Palæolodus, 154
 Palæornis, 360
 Palæornithidae, 359
 Palapteryx, 44
 Palamedæ, 134
 Palate, 10
 Paludicola, 122
 Pamprodactylous, 370, 394
 Pandion, 293
 Pandioninae, 293
 Panoplitæ, 454
 Panterpe, 443
 Panychlora, 442
 Panyptila, 439
 Paradisea, 549
 Paradise birds, 519
 Paradiseidae, 516
 Paradiseinae, 516
 Parakeet, black-billed, 367
 " Carolina, 365
 " grass, 355, 356
 " gray-breasted, 366
 " ground, 356
 " hanging, 360
 " monk, 366
 " red-tailed, 366
 " rosella, 357
 Parotia, 521
 Parra, 104
 Parrot, bat, 359
 " gray, 363
 " green, 367
 " ground, 351
 " jaco, 364
 " kaka, 353
 " Madagascar, 360
 " owl, 350
 " Philip Island, 352
 " racket-tailed, 362
 " ring, 361
 " vasa, 363
 Parrots, 349
 Parson-bird, 535
 Partridge, 52
 " bamboo, 203
 " crested, 206
 " gray, 204
 " hill, 201
 " plumed, 206
 " red-legged, 201
 " swamp, 204
 " Tibetan, 200
 Partridge-dove, 246
 Partridges 198, 200, 205
 Parus, 515
 Passer, 546
 Passeres, 458
 Passeriformes, 370
 Passeroides, 460, 481
 Pastor, 532
 Patagona, 453
 Pauxis, 233
 Pavo, 229
 Pavoncella, 108
 Peacock, 229
 Peacock-pheasant, 228
 Peafowl, 229
 Pedicetes, 209
 Peewit, 59
 Pelargomorphæ, 157
 Pelargopappus, 163
 Pelecanidae, 185
 Pelecaniformes, 65
 Pelecanoididae, 90, 185
 Pelecanoides, 91
 Pelecanus, 186
 Pelicans, 184, 188
 Penelope, 233
 Penclopina, 233
 Penclopinae, 233
 Penguin, Apterous, 49
 " northern, 72
 Penguins, 56
 Penthoceryx, 374
 Perdicinae, 198
 Perdicula, 199
 Perdix, 200
 Perdiz, 52
 Peregrine, 309
 Pericrocotus, 509
 Perisoreus, 524
 Peristera, 246, 247
 Peristeripodes, 229
 Pernis, 299
 Petasphora, 454
 Petrels, 88, 91
 Petrochelidon, 507, 509
 Petronia, 546
 Petrophassa, 246
 Peucea, 547
 Pezophaps, 239
 Pezoporus, 352
 Phaenorrhinus, 258
 Phaethon, 181
 Phaethontoides, 181
 Phaethornis, 456
 Phalacrocoracidae, 190
 Phalacrocorax, 191
 Phalaropes, 107
 Phalaropodinae, 107
 Phaps, 244
 Pharaoh's chicken, 278
 Pharomacrus, 434
 Phasianidae, 213
 Phasianinae, 216
 Phasianus, 216, 220
 Phasidus, 215
 Pheasant, argus, 227
 " blood, 216
 " crow, 381
 " eared, 226
 " English, 222
 " fireback, 216
 " golden, 219
 " impeyan, 225
 " kaleege, 216
 " kalij, 216
 " koklass, 223
 " Lady Amherst, 219
 " L'huysii's, 225
 " lyre-tailed, 461
 " peacock, 228
 " pectoratus, 224
 " Reeve's, 224
 " Sclater's, 225
 " silver, 216, 217
 " snow, 202
 " Wallich's, 221
 " white-winged, 222
 Pheasants, 204, 215
 Philabura, 474
 Philacte, 142
 Philepitta, 465
 Philepittidae, 465
 Philitarus, 542
 Philagenas, 243
 Philogophilus, 444
 Phodilus, 324, 346
 Phoenicoparra, 154
 Phoenicopteridae, 154
 Phoenicopleroides, 153
 Phoenicopterus, 151
 Phorakema, 451
 Photodilus, 324, 346
 Phyllopusseus, 504
 Phytotoma, 475
 Phytotomidae, 475
 Piaya, 375
 Pica, 526
 Picapare, 68
 Picariae, 368
 Picicorvus, 526
 Picidae, 412, 423
 Piciformes, 370, 412
 Picinae, 426
 Picoides, 412
 Picoides, 429
 Piculets, 425
 Picumninae, 425
 Picumnus, 425
 Picus, 428
 Pigeon, blue-headed, 243
 " bronze-wing, 245
 " brush, 245
 " Cape, 90
 " crested, 245
 " crowned, 241
 " green, 255
 " ground, 242
 " Nicobar, 244
 " passenger, 251
 " pheasant-tailed, 250
 " stock, 253
 " tooth-billed, 210
 " white-crowned, 254
 " wild, 251
 Pigeons, 237
 Pinnipedes, 56
 Pintail, 148
 Pionidae, 367
 Pipile, 233
 Pipits, 487
 Piranga, 541
 Pirigui, 384
 Pipra, 472
 Pipridæ, 472
 Pityline, 547
 Plant-cutters, 475
 Plantain-eaters, 371
 Platea, 161
 Platycercidae, 354
 Platycercus, 356
 Platyrhynchus, 471
 Plantus, 72
 Plectrophenax, 546
 Plectropteridae, 140
 Plectropterus, 14
 Plegadis, 160
 Plietolophidae, 353
 Plietolophus, 353
 Plietolophus, 354
 Ploceidae, 542
 Plotus, 163
 Plover, crab, 97
 " crook-billed, 101
 " golden, 96
 " spur-winged, 100
 " stone, 112
 " wry-billed, 101
 Plovers, 98
 Pluviales, 65
 Pluvialiformes, 65
 Pluvianellus, 99
 Pluvianus, 100
 Pnecopygæ, 57
 Pnecopygæ, 57
 Podargus, 387
 Podica, 68
 Podiceps, 67
 Podilymbus, 68
 Podocypidae, 66
 Pogonorrhynchus, 420

- Polioætus, 284
 Polioptila, 507
 Polioptilinae, 507
 Polyborina, 300
 Polyboroides, 295
 Polyborus, 301
 Polyplectron, 227
 Polytus, 443
 Porocephalus, 367
 Porphyrio, 131
 Porzana, 128
 Poule rouge, 129
 Powder-downs, 4
 Præcoes, 3
 Prairie-chickens, 209
 Prairie-hens, 209
 Pratincola, 498
 Pratincoles, 45
 Primaries, 3
 Prion, 90
 Prioniturus, 362
 Priotelus, 435
 Procellaria, 88
 Procellariidae, 88
 Procellariinae, 89
 Procellarioides, 84
 Progne, 509
 Prosthemadera, 535
 Protonotaria, 510
 Psalidoprocne, 509
 Pseudotantalus, 163
 Psittacella, 358
 Psittaci, 349
 Psittacidae, 363
 Psittacula, 367
 Psittacus, 364
 Psophia, 123
 Psophida, 122
 Ptarmigan, 207
 Ptermistes, 204
 Pterocles, 235
 Pterocletes, 235
 Pteroenemia, 38
 Pterocorys, 486
 Pteroclidæ, 235
 Pteroglossus, 417
 Pteropappi, 23
 Pteropades, 3
 Pterophanes, 453
 Pteroptochidae, 476
 Pterylæ, 3
 Ptilopachus, 201
 Ptilopteri, 56
 Ptilonorhynchus, 566
 Ptilorhis, 522
 Ptilopus, 256
 Pucras, 223
 Pucrasia, 223
 Puff-birds, 413
 Puffins, 73
 Pukeko, 131
 Pycnaspidæan, 464
 Pycnonotina, 490
 Pycnonotus, 490
 Pygarrichus, 479
 Pygopodes, 56, 65
 Pygoseclis, 59
 Pygostyle, 12
 Pyrocephalus, 471
 Pyroderus, 471
 Pyrrhocorax, 528
 Pyrrhulauda, 486
 Pyrrhura, 366

 Quails, 198-206
 Quesal, 434
 Quiscalus, 532
 Quits, 510

 Rails, 127

 Rallidæ, 127
 Rallus, 128
 Ramphastidae, 412, 414
 Ramphastos, 414
 Raptatores, 260
 Raptores, 260
 Rasores, 197
 Ratite, 32
 Raven, 526
 Razor-bill, 72
 Rectrices, 4
 Recurvirostra, 107
 Recurvirostrinae, 107
 Regulinae, 501
 Regulus, 501
 Reinwardtæna, 249
 Reticulate tarsus, 9
 Rhamphocelus, 511
 Rhamphomicron, 445
 Rhea, 38
 Rheoidea, 37
 Rheinardius, 227
 Rhinoplax, 408
 Rhipidura, 492
 Rhodonessa, 146, 148
 Rhodostetha, 79
 Rhyncha, 110
 Rhynchopinae, 83
 Rhynchops, 83
 Rhynchotus, 52
 Rhynchoetidae, 117
 Rhynchoetes, 117
 Ridgwayia, 491
 Rifleman, 465
 Ring ouzel, 496
 Rissa, 81
 Road-runner, 381
 Roa-roa, 49
 Robin, American, 496
 " English, 496
 Roc, 47
 Rock-hopper, 63
 Rollers, 389
 Rollulus, 200
 Rostrhamus, 298
 Rostratula, 110
 Rotge, 69
 Roulroul, 200
 Ruby-throat, 450
 Ruc, 47
 Rupicola, 473
 Ruff, 108
 Rufibrenta, 142

 Sacfa, 200
 Sage-cock, 209
 Salpinctes, 505
 Sanderling, 107
 Sand-grouse, 235
 Sandpipers, 107
 Sappho, 446
 Sap-suckers, 432
 Sarcorhamphus, 268
 Sarkedornis, 146
 Sasia, 426
 Saurgnathous, 10, 423
 Saurura, 21
 Saxicola, 498
 Scardafella, 247
 Schistes, 444
 Schizognathous, 10
 Schizorhinal, 11
 Schizopelmous, 369
 Scissor-tail, 470
 Schlegelia, 522
 Scleroptera, 203
 Scolopacidae, 105
 Scolopacinae, 110
 Scolopacoides, 91
 Scopidae, 170

 Scops, 341
 Scopus, 570
 Scoters, 148
 Scotopelia, 337
 Screamers, 132
 Scrub-birds, 462
 Scutellate tarsus, 9
 Scytalopus, 476
 Seythrops, 378
 Sea-dove, 69
 Sea-hawk, 77
 Sea-hen, 75
 Sea-swallow, 188
 Secondaries, 3
 Secretary, 263
 Seleucides, 522
 Selasphorus, 449
 Semioptera, 522
 Semiplumes, 4
 Senculus, 516
 Seriemas, 121
 Serrati, 136
 Serratirostris, 397
 Serresius, 258
 Serrirostris, 56
 Shags, 191
 Shame-bird, 257
 Sharp-tails, 209
 Shearwater, 83, 90
 Sheath-bills, 92
 Sheldrake, 146
 Shoe-bill, 171
 Shovelers, 148
 Shirike, ant, 477
 " cuckoo, 509
 " crow, 511
 " drongo, 509
 " swallow, 511
 " true, 511
 Sialia, 491
 Sifters, 136
 Silvia, 502
 Silvinae, 501
 Simorhynchus, 72
 Sisura, 493
 Sitta, 515
 Sittace, 365
 Sittinae, 514
 Skua, 75
 Skimmers, 83
 Skull, 10
 Snake-bird, 195, 433
 Snipes, 110
 Snow-cocks, 202
 Snow-flake, 546
 Solan goose, 188
 Solitaire, 239, 491
 Solitary, 239
 Somateria, 150
 Soroplex, 428
 Soufrière bird, 491
 Spatula, 148
 Sparrow, hedge, 492
 " English, 516
 Sparrow-hawks, 304, 306
 Spectacled guillemot, 72
 Speotyto, 321
 Spheniscidae, 56
 Spheniscus, 59
 Sphenoproetus, 456
 Sphenorhynchus, 167
 Sphyrapicus, 432
 Spilornis, 286
 Spindalis, 541
 Spinus, 547
 Spizaetus, 285
 Spizella, 547
 Spizastur, 285
 Spiziapteryx, 309
 Spoon-bills, 158, 161

- Sporadinus, 442
 Stake-driver, 177
 Standard-wing, 522
 Starlings, 529
 Sturnellas, 243
 Steatornis, 385
 Steatornithidae, 385
 Steatornithoides, 371
 Steganopodes, 56, 179
 Steganura, 418
 Stegnolaema, 233
 Stelgidopteryx, 509
 Stellula, 419
 Stenostira, 507
 Sterna, 81, 83
 Stercorariidae, 75
 Stercorarius, 76
 Sternoclyta, 454
 Sternula, 83
 Sthelenides, 143
 Stictænas, 253
 Stint, Temmincks, 108
 Stipiturus, 499
 Stone chat, 498
 Storks, 162-169
 Strepera, 511
 Streptopelia, 249
 Strigidae, 263, 321
 Striginae, 324
 Stringopidae, 350
 Stringops, 350
 Struthio, 33
 Struthiolithus, 55
 Struthioidea, 33
 Struthiones, 32
 Struthionidae, 33
 Sturnidae, 529
 Sturnus, 531
 Sula, 188
 Sulidae, 188
 Sun-birds, 536
 Sun-bitterns, 115
 Sun-grebes, 68
 Surf-bird, 99
 Surf-ducks, 148
 Surnia, 344
 Surniculus, 380
 Suthora, 514
 Suthorinae, 514
 Sutoria, 499
 Sun-gein, 450
 Swallow, bank, 509
 " barn, 509
 " chimney, 439
 " rough winged, 509
 " sea, 188
 " white-bellied, 509
 " wood, 511
 Swallow-shrikes, 511
 Swallows, 507
 Swans, 143
 Swiftlets, 437
 Swifts, 437
 Synallaxinae, 480
 Synallaxis, 479
 Synoicus, 199
 Synpelmous, 369
 Syornis, 41
 Syrinx, 373
 Syrmaticus, 220
 Syrnium, 345
 Syrrhaptes, 235

 Tachornis, 440
 Tachyeres, 149
 Tadorna, 146
 Tailor-bird, 499
 Tallegallinae, 231
 Tallegallus, 231
 Tanagers, 541
 Tanagra, 541
 Tanagridae, 441
 Tantalus, 164
 Tanygnathus, 362
 Tanyptera, 402
 Taoniscus, 54
 Tarapunga, 79
 Tarsus, 464
 Tattler, 107
 Taxaspidean, 464
 Teaser, 76
 Temnotrogon, 435
 Temnirostris, 484, 531
 Terpsiphone, 492
 Terns, 77, 81
 Tertiaries, 3
 Tetragonops, 420
 Tetrao, 209
 Tetraonidae, 198
 Tetraoninae, 207
 Tetraophasis, 225
 Tetrapteryx, 125
 Thalassens, 83
 Thamnophilinae, 477
 Thaumalea, 216, 219
 Thick-knees, 112
 Thinocoridae, 93
 Thinocoris, 93
 Thorn-bird, 480
 Thrasactus, 287
 Thrush, ant, 466, 477
 " babbling, 490
 " fruit, 490
 " ground, 467
 " song, 491
 " wood, 491
 Thrushes, 493
 Tiga, 427
 Tichodroma, 539
 Timaliidae, 490
 Tilmatura, 449
 Timolia, 443
 Tinaminae, 54
 Tinamotinae, 54
 Tinamous, 54
 Tinnunculus, 306, 315
 Tit, ground, 506
 " wren, 506
 Tits, hill, 491
 " true, 515
 Tityra, 474
 Tockus, 404
 Toco, 417
 Todidae, 395, 399
 Todies, 399
 Todirostrum, 471
 Todus, 399
 Toothed birds, 23
 Topaza, 452
 Toporok, 74
 Totanus, 108
 Toucans, 414
 Tracheophonae, 459
 Trachyphonus, 420
 Tragopans, 224
 Tree-ducks, 145, 146
 Treron, 255
 Treronidae, 254
 Trichoglossidae, 358
 Trichoglossus, 358
 Tringinae, 107
 Trochilidae, 441
 Trochilos, 100
 Trochilus, 449
 Troglodytes, 476
 Troglodytidae, 505
 Trogonidae, 433
 Trogoniidae, 433
 Trogons, 433
 Tropic-birds, 181
 Troupial, 545
 Trumpeter, 123, 143
 Tulinarens, 65, 81
 Turacinae, 249
 Turacou, 372
 Turacus, 372
 Turdidae, 493
 Turdus, 494
 Turkey-buzzard, 267
 Turkeys, 222
 Turkey, brush, 232
 Turnstones, 98
 Turtle-dove, 248
 Turtur, 248
 Tympanistria, 246
 Tyrannidae, 468
 Tyrannoides, 460, 463
 Tyrannus, 469, 471
 Tyrant birds, 468

 Umber-bird, 170
 Umbrella bird, 474
 Umbrette, 170
 Under coverts, 4
 Upper coverts, 4
 Upupa, 410, 411
 Upupidae, 411
 Upupoides, 408
 Uranomitra, 443
 Uria, 71
 Urinator, 69
 Urinatoridae, 69
 Urochroa, 454
 Urocissa, 526
 Urogalba, 414
 Urubitinga, 290

 Vaginati, 92
 Vanellus, 99
 Vaza, 363
 Verreauxia, 425
 Vida, 513
 Vidua, 543
 Vidua loca, 127
 Virago, 145
 Virconidae, 513
 Virconinae, 513
 Vivia, 426
 Vultur, 274
 Vulture, bearded, 280
 " black, 266
 " California, 268
 " crested black, 274
 " eagle, 279
 " eared, 274
 " Egyptian, 277
 " fulvous, 274
 " griffon, 275
 " king, 268
 " Nubian, 277
 " Pondicherry, 277
 " Rüppell's, 276
 " white, 278
 Vultures, American, 266
 " Old World, 273
 " true, 274
 Vulturinae, 273

 Waders, 92
 Warbler, fantail, 499
 " grass, 499
 " grasshopper, 502
 " Prothonotary, 510
 Warblers, American, 510
 Wax-bills, 543
 Wax-wing, Bohemian, 511
 Weaver-birds, 542
 Weka, 129
 Western grebe, 67
 Wheatears, 498

Whinchat, 498
 Whip-poor-will, 589
 Whiskey-jack, 524
 Wood-cock, 105
 Wood-hens, 128
 Wood-larks, 478
 Woodpeckers, 462
 Woodpeckers, 423, 426
 Wren, ant 477
 " cañon, 505
 " emu, 499

Wren, tyrant, 468
 Wrens, 502
 Wren-tit, 506
 Wry-neck, 433
 Xanthocephalus, 516
 Xanthocephalus, 526
 Xenops, 84
 Xenops, 465
 Xenops, 465
 Xenops, 479

Xipholana, 474
 Yaffle, 428
 Yakamik, 123
 Ynambu, 54
 Yungipicus, 423
 Zamelia, 247
 Zamelia, 250
 Zamelia, 547
 Zygodactylus, 308

E R R A T A.

The reader is requested to make the following Errata in the present volume:—

- Page 9, line 1, for "and" read "but not."
- Page 10, fig. 3, for "*pux*" read "*mzp*."
- Page 11, fig. 5, legend, for "of the skull of a sparrow" read "of a sparrow-like palatē."
- Page 12, line 40, for "metatarsal" read "metacarpal."
- Page 15, line 2, strike out "third."
- Page 48, line 37, for "Alfonse" read "Alfred."
- Page 49, line 35, for "rectrices" read "remiges."
- Page 68, line 1, for "variations" read "varieties."
- Page 80, line 16, for "Murdoch" read "Murdoch."
- Page 97, line 18, for "Charadriidæ" read "Charadriidæ."
- Page 112, line 17, for "*bistritatus*" read "*bistriatus*."
- Page 139, line 9, for "*rüppellii*" read "*rüppellii*."
- Page 148, line 12, for "*clypeator*" read "*clypeata*."
- Page 163, line 8, read "Fig. 79. — *Pseudotantalus rhodinopterus*, African wood-ibis."
- Page 169, line 17, for "black" read "yellow."
- Page 180, line 19, for "+" read " $\frac{+}{-}$."
- Page 188, line 14, for "speckled" read "spectacled."
- Page 371, line 25, for "Ethiopian" read "Ethiopian."
- Page 433, line 35, for "desmognathous" read "schizognathous."

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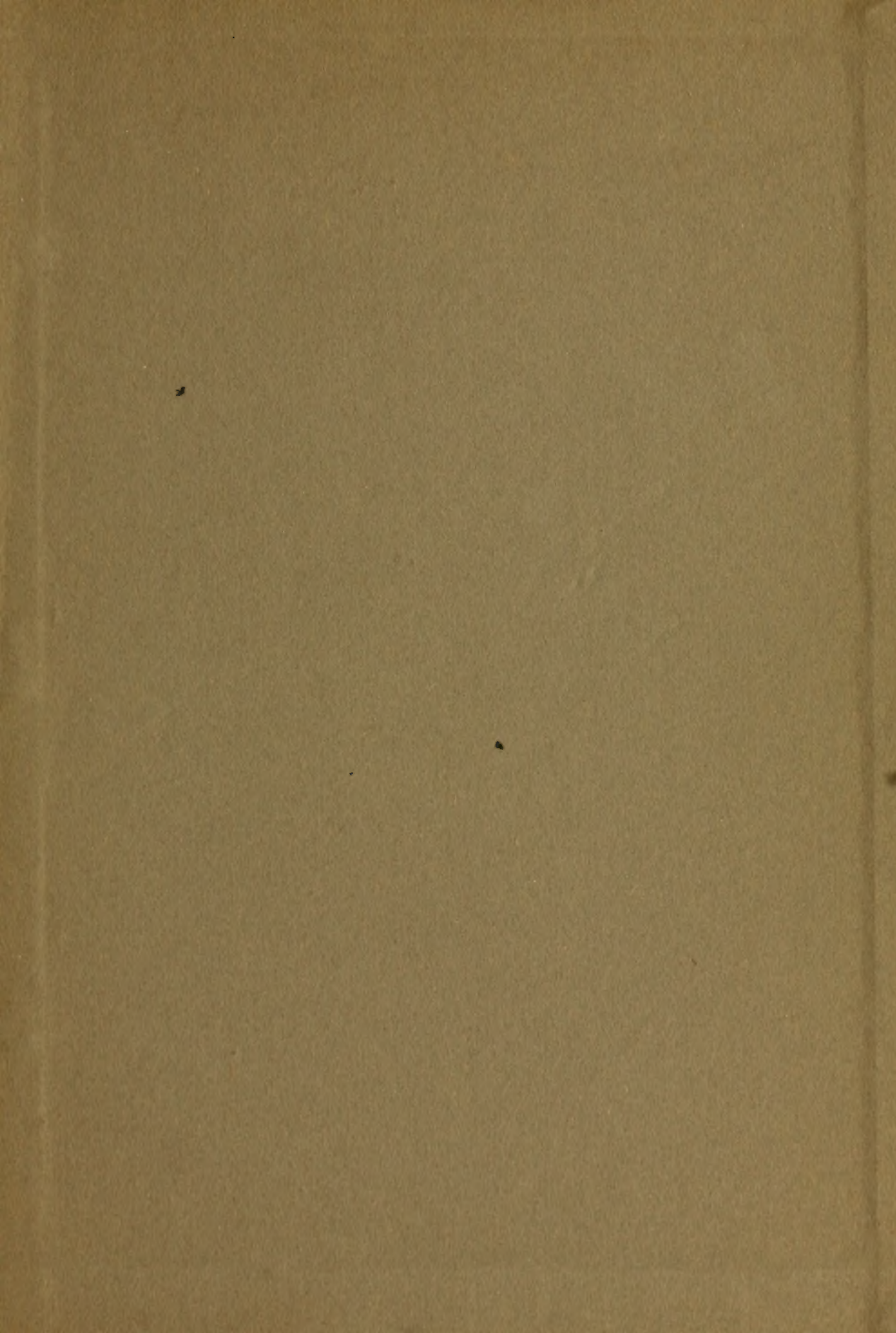
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